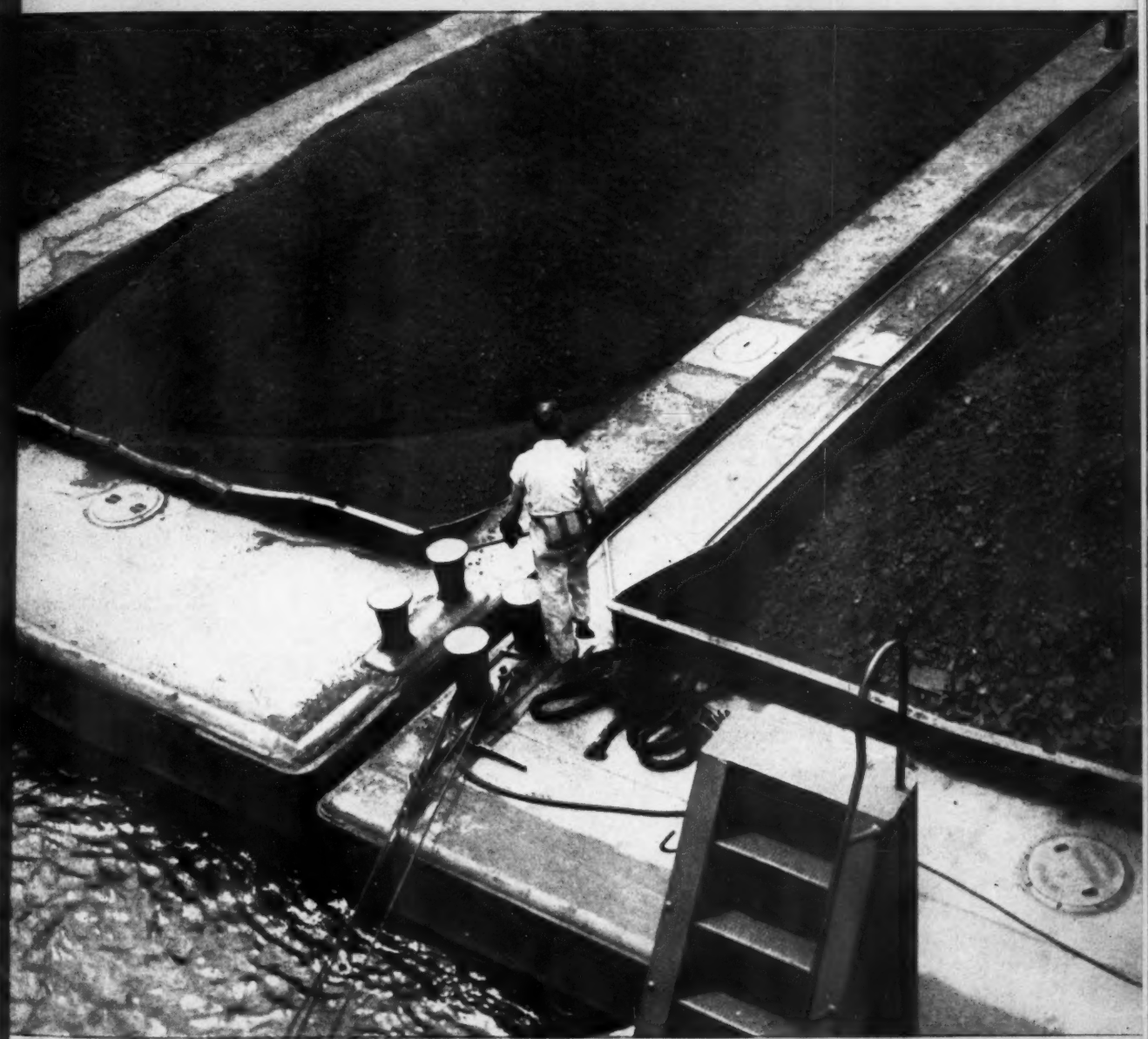
Mining CONGRESS JOURNAL

AMERICAN MINING CONGRESS

OCTOBER
1955



OVER MILLION YARDS OF SOLID ROCK MOVED FOR TAIL RACE

Moving more than a million yards of rock for the tail race of a southern dam is a typical job for a MARION 151-M.

BIG jobs in HARD digging are common assignments for the MARION 151-M. A reputation for big production on mining projects throughout the world makes this 7-yard shovel a logical choice for the toughest construction jobs.

Ask for Bulletin 393 which shows some of the many design and construction features of the 151-M that make these performance records possible.

MARION / **MARION POWER SHOVEL COMPANY**
MARION, OHIO, U. S. A.

POWER SHOVELS FROM ½ TO 60 CUBIC YARDS • DRAGLINES • CLAMSHELLS • LOG LOADERS
PILE DRIVERS • WALKING DRAGLINES • CRANES, CRAWLER & RUBBER MOUNTED • BACKHOES

CF&I ROCK BOLTS

make mine roofs and walls *SELF-SUPPORTING*

Conventional mine timbering is as old-fashioned as it is cumbersome, dangerous and expensive.

With CF&I Rock Bolts, there's no need for bulky timbers that require added transportation and installation, that restrict the efficient operation of machinery and limit miners' output. CF&I Rock Bolts are simply anchored in mine roofs and walls, and give secure support.

CF&I Rock Bolts offer these advantages:

- **Reduce danger of roof falls due to blast effect**
- **Provide valuable additional working space**
- **Afford better ventilation**
- **Are less bulky to store and haul**
- **Low-cost installation**

SLOT & WEDGE TYPE

EXPANSION SHELL TYPE

CF&I Rock Bolts are available in slot and wedge type and expansion shell type with Pattin shell.

Learn how CF&I Rock Bolts can improve your own operations. Write today for descriptive information.

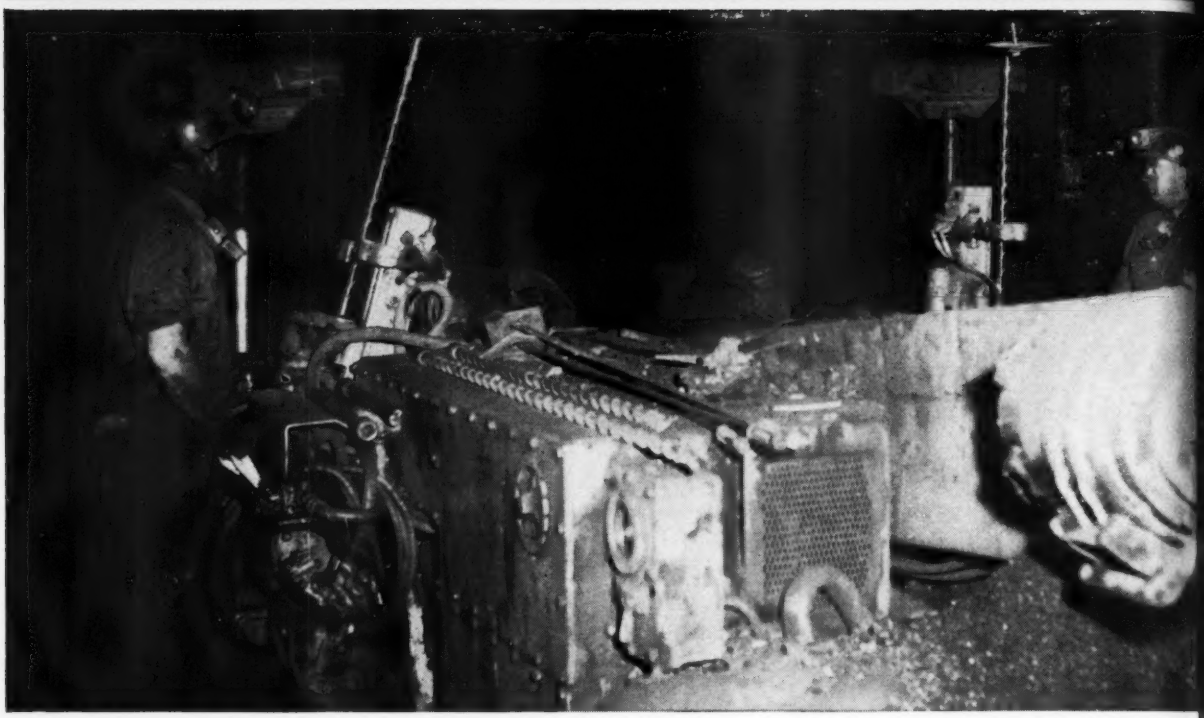
3185

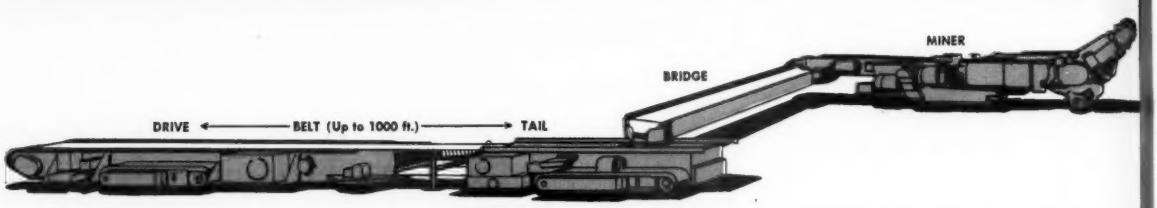
CF&I ROCK BOLTS

CF&I STEEL PRODUCTS FOR THE MINING INDUSTRY

Grinding Balls • Grinding Rods • Wickwire Rope • Mine Rails and Accessories • Cal-Wic Industrial Screens

TONS PRODUCED PER MAN-SHIFT





The JOY "1-CM-EX-BELT" COMBINATION

points the way to increase your profit margin

Here's a mining team that can really slash your production costs, as the operating figures on the facing page adequately prove. The Joy 1-CM Continuous Miner, teamed with the Joy Extensible Belt Conveyor for continuous haulage, provides a combination that is the absolute last word in low-cost, high-production mechanized mining in seams of 52" and higher.

For lower coal, the popular 3-JCM Continuous Miner—only 34" high over-all—takes over the extracting job. And for full-face mining in seams of approximately 6 to 8 ft., the powerful Joy Twin Borer is now available for continuous production at an 8-ton-a-minute clip.

The 1-CM Miner has a capacity of 4 tons per minute, is 45" high over-all, and will cut from 5½" below floor to 90" above (120" with special equipment). It is available with two hydraulic roof drills of 4200-lb. thrust (note the photograph above) making the 1-CM a fully integrated unit capable of handling both advance and roof control.

The Joy "Ex-Belt" Conveyor (see drawing above) now permits a continuous mining machine to operate *almost without interruption* in driving rooms and entries up as far as 1000 feet, including breakthroughs and taking pillar on retreat. It is available in 24, 30 and 36-inch widths and consists of two main units: a drive and a tail section with bridge conveyor, both self-propelled on identical crawler treads.

The "Ex-Belt" extends or retracts 50 feet while operating under full load. Belt tension and slippage are under automatic control at all times. A 100-foot length of belt can be added or removed, as needed, in an average time of only 5.3 minutes, and the entire system can be moved over and set up for a new heading in less than 2 hours.

. . . FIRST, went up 40%

when a JOY I-CM Continuous Miner was used instead of conventional methods

THEN, increased 38% more

when a JOY Extensible Belt Conveyor was added to provide continuous haulage

	1 MONTH'S RUN I-CM MINER ONLY	2 MOS. 20 DAYS' RUN I-CM MINER-"EX-BELT" COMBINATION
TOTAL PRODUCTION (RAW COAL)	17,818 TONS	51,253 TONS
TOTAL SHIFTS WORKED (TWO ON- ONE OFF)	39	107
AVERAGE PRODUCTION PER SHIFT	457 TONS	479 TONS
BEST PRODUCTION SHIFT	650 TONS	831 TONS
WORKING CREW CHARGED TO THE EQUIPMENT PER SHIFT	8½ MEN	7 MEN
AVERAGE PRODUCTION PER MAN PER SHIFT	53.8 TONS	68.4 TONS

The results above cover two regular periods of operation in a West Virginia mine. The coal is in the Pittsburgh seam and averages about 8 feet in thickness. It contains numerous clay veins up to 4 feet thick, resulting in both bad top and bottom when encountered, and requiring the hauling of considerable waste material. Mining height is limited to about 7 feet, leaving some head coal for roof support, and some bottom because of impurities.

In the first operating period of a month, the Joy 1-CM Miner was teamed with two Joy 10-SC shuttle cars unloading on belt conveyors. Production per man-shift averaged 53.8 tons, *an increase of 40% over conventional mining methods.* Size consist also improved with 1-CM production, with the sizes over 3/8" increasing from 69.1% to 74.7% of the total, on the average.

In the second period of nearly three months, a Joy "Ex-Belt" Conveyor replaced the shuttle cars. *Production per man-shift jumped to 68.4 tons, an additional increase of 38% and a total increase of 78% over the methods previously used!*

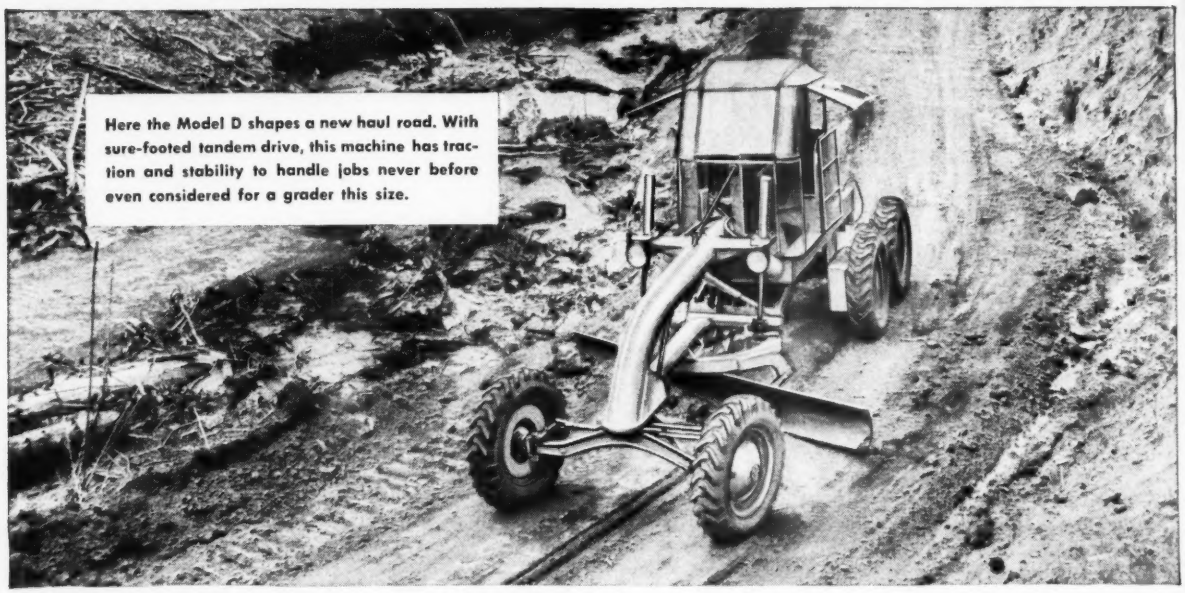
What would results like these do for *your* profit margin? Let us help you to secure real cost reductions under today's conditions, with rugged, field-proved equipment that is built to stay on the job. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer

JOY

WORLD'S LARGEST MANUFACTURER OF UNDERGROUND MINING EQUIPMENT

W&D CL 5736



Here the Model D shapes a new haul road. With sure-footed tandem drive, this machine has traction and stability to handle jobs never before even considered for a grader this size.

Graded Haul Roads Increase Your Earnings

HAUL roads shaped and maintained with your own motor grader help step up output and cut costs on logging operations. Here's why:

1 Grader-maintained roads are smoother, better contoured—permit hauling units to make more trips per day.

2 Frequent grading eliminates ruts and potholes, cuts costly wear and strains on trucks.

3 Operations can proceed on schedule *in any weather* —graded roads drain fast, dry quickly.

And you get all these advantages . . . at the lowest possible cost with the Allis-Chalmers Model D.

First, it is built for the job, with all the features of a big grader — tandem drive, power hydraulic controls, fully visible blade, high-arch front axle, optional leaning front wheels, and power circle turn — yet costs only ⅓ as much as the large machines. It has the power, traction and balance to keep roads in really serviceable condition at far less cost than bigger, more expensive equipment.

The Model D is economical to own and operate — runs all day on a tank of gas. Even an inexperienced person can learn to run this machine in a surprisingly short time.

The Model D is available with a choice of gasoline or diesel engines. A full range of accessories include rear-end loader, scarifier, windrow eliminator, all-view cab, heavy-duty front tires, blade and V-type snowplows.

Write now for free catalog or see your Allis-Chalmers dealer for a demonstration.

CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

WEIGHT: 8,800 lb.
BRAKE HP: 50

SPEEDS: Four forward to 25.6 mph
Reverse to 3.3 mph

Here the Model D loads gravel from a hillside bed . . .

and carries it out to a soft spot in the haul road. This rear-mounted hydraulic shovel with ⅝-yd bucket loads dirt, stockpiles bulk material, etc.

OCTOBER, 1955

VOLUME 41 ● NUMBER 10

Mining CONGRESS JOURNAL

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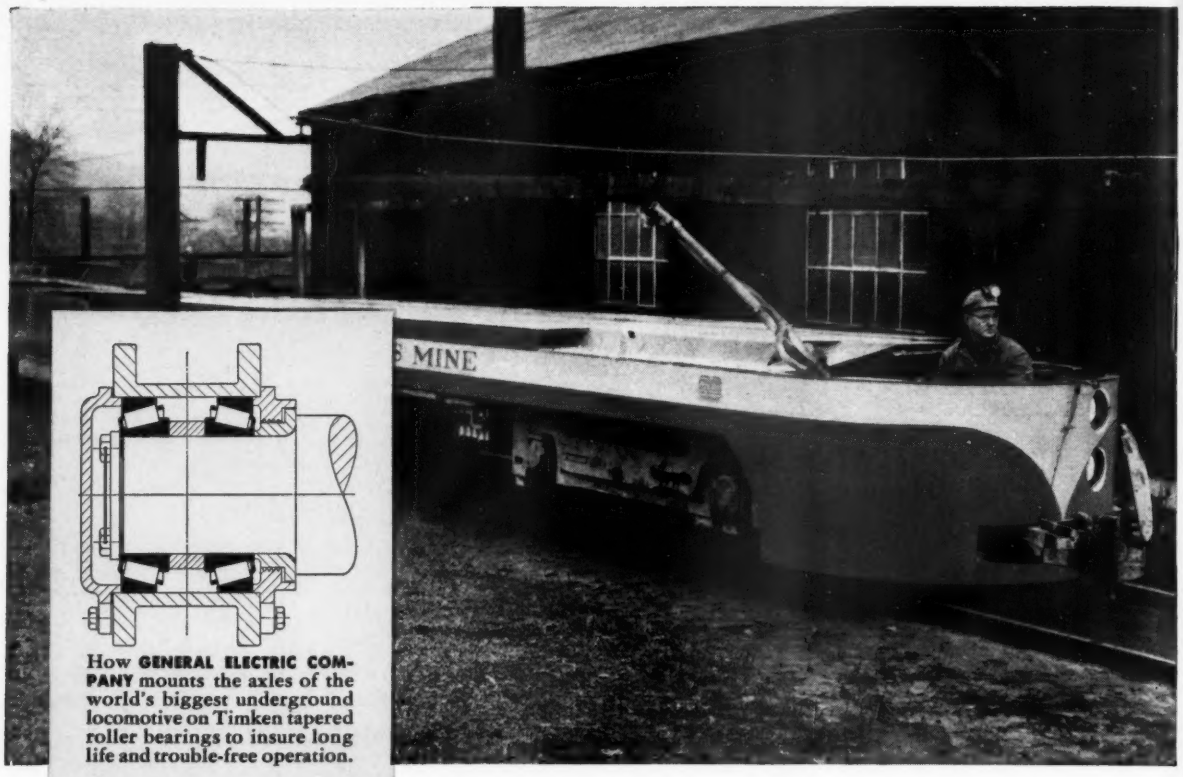


How **GENERAL ELECTRIC COMPANY** mounts the axles of the world's biggest underground locomotive on Timken tapered roller bearings to insure long life and trouble-free operation.

World's biggest underground mine locomotive rolls on 16 TIMKEN® bearings

THE world's largest and most powerful underground locomotive, built by the General Electric Company, is now in operation pulling probably the largest coal loads ever hauled by a single unit locomotive. With a rated drawbar pull of 25,000 pounds, this locomotive is capable of pulling 1600 tons, or the equivalent of approximately 110 loaded mine cars, on a straight, level track. To insure against costly breakdowns in the mine and to help the locomotive stand up under the back-and-forth, day-after-day wear and tear of heavy-duty mine operations, General Electric used Timken® tapered roller bearings on the axles.

The tapered construction of Timken bearings lets them take thrust as well as radial loads, without the need for extra thrust plates or bearings. The locomotive takes curves easier. By holding hubs and axles concentric, Timken bearings make closures more effective. Lubricant stays in—dirt, coal, dust and moisture stay out.

Full line contact between rollers and races of Timken bearings provides more than enough capacity for heavy loads.

Be sure you specify Timken bearings in the equipment you buy or build. They give longer life, less friction, minimum maintenance. Always look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

OUR OWN NICKEL-RICH ALLOY STEEL MAKES TIMKEN BEARINGS TOUGHER

Nickel makes steel tougher. And we don't skimp on nickel in the fine alloy steel we make for Timken bearings. Our steel-making specialists use the exact amount to give Timken bearings the toughness they need to withstand shock, last longer. We control the quality of Timken bearings at every step in production—from melt shop through final bearing inspection.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭

BEARING TAKES RADIAL ↓ AND THRUST →○← LOADS OR ANY COMBINATION

Constant savings 9 ways!

1 **NON-STOP LOADING** is permitted by the new revolutionary articulated design which eliminates space between cars.

2 **NON-STOP DUMPING** is provided by ACF's maintenance-free drop bottom cars.

3 **NO SPILLAGE** during loading or fast "runs".

4 **NO WIDE "TURNOUTS"** or extra timbering are needed because of reduced overhang.

5 **LESS MAINTENANCE** is required because special trucks, one set per two cars, eliminate flange wear and side play... assure perfect wheel alignment even on curves.

6 **SHORTER TRAINS AND FEWER CARS** are possible because no space is wasted between the long, extra-capacity cars.

7 **SHUT DOWN PROOF** operation is assured because a damaged car can be repaired while the rest of the trip goes on working.

8 **TWO-WAY PAY LOADS:** same trip can bring out the coal and take in supplies.

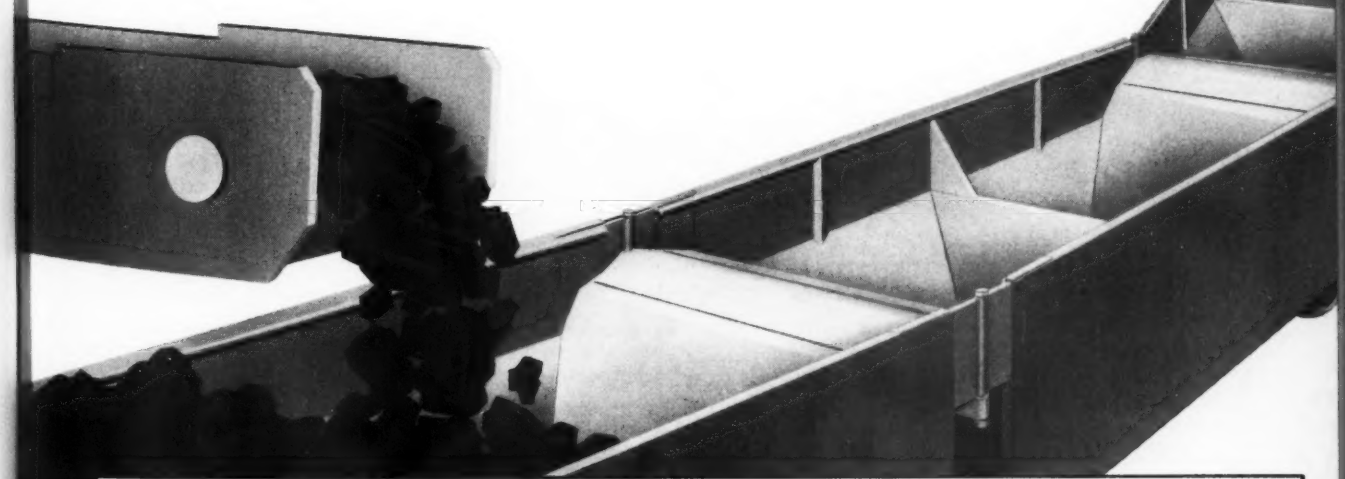
9 **GREATER FLEXIBLITY:** capacity of new type cars can be varied to meet your particular needs... later on, your entire haulage system can be easily modified to meet new demands of production.

acf

articu-trip

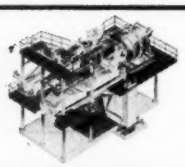
MINE CARS

ASK YOUR ACF REPRESENTATIVE for complete information. American Car and Foundry, a division of ACF Industries, Incorporated, New York • Chicago • St. Louis Cleveland • Philadelphia • Washington • San Francisco • Berwick, Pa. Huntington, W. Va.



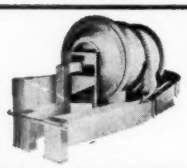
acf **MINE CARS** *for Constant Haulage*

Wemco answers your coal cleaning problems



WEMCO HMS MOBIL-MILLS

World's most widely used heavy media separation plants; available with a choice of separatory vessels; capacities 25 to 500 TPH; will handle feed range from 8" to 3/32".

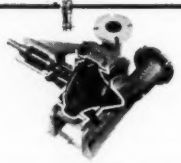


TWO-COMPARTMENT DRUM SEPARATORS

Two-gravity, three-product heavy media separation in one vessel. Less than 1% misplaced material on a feed of 114 TPH of 2½" x ¼" coal indicated in typical operating report.

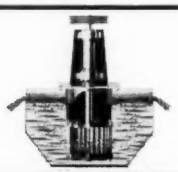
WEMCO HMS EQUIPMENT FOR CUSTOM PLANTS

Separatory drums and cones, densifiers, medium pumps and media reclamation circuits of the superior designs so thoroughly proven in the Wemco Mobil-Mills.



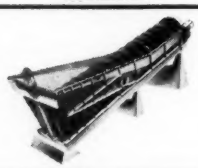
WEMCO TORQUE-FLOW SOLIDS PUMP

A remarkable new pump that can handle chunks up to several inches in diameter; available in capacities 100 to 3,000 GPM; handles heads up to 120 feet.



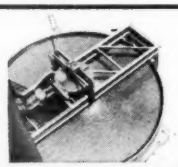
FAGERGREN FLOTATION MACHINES

Most efficient per cubic foot of all modern flotation machines. Extract saleable coal in the range from 14 to 325 mesh plus solving disposal problem.



WEMCO COAL SPIRALS

Efficient, low cost dewatering and/or sizing device that achieves more complete moisture removal than the drag tank; also fewer working parts and no stalling problems.



WEMCO HYDROSEPARATORS

High capacity means for making an efficient separation in the 200 mesh range; used to deslime coal ahead of tabling or flotation; diameters to 150 feet.

WEMCO LABORATORY SERVICES

All necessary tests are available to determine practicability of various coal cleaning methods for treating your run-of-mine coal.

WEMCO THICKENERS

The perfect compromise between acreage and horsepower in clarifying water for closed circuits, or for pollution-free stream disposal; diameters to 400 feet.

The full available information on any of the above equipment items will gladly be mailed in answer to your inquiry. More detailed recommendations for your specific coal cleaning problem will also be furnished, if desired. Write Dept. I-2212

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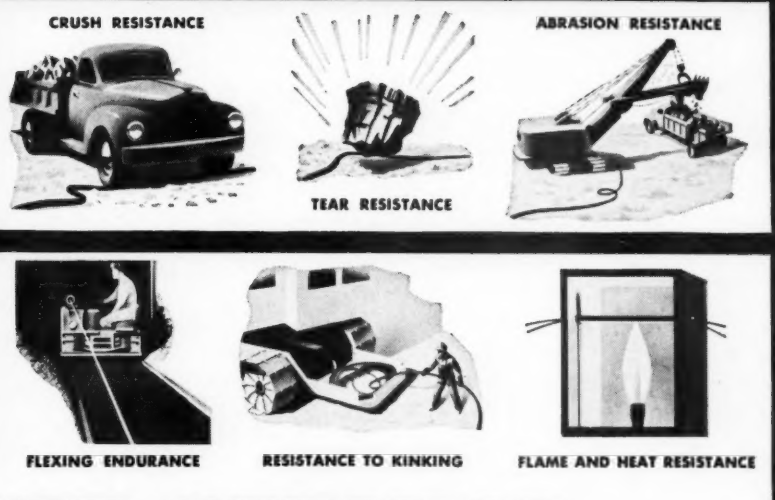
THE GREATEST NAME IN ELECTRICAL WIRE AND CABLE

resists all hazards far beyond accepted field requirements



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Heavy Duty Mold-Cured Portable Cords and Cables

Constant research . . . both in our laboratories and in the field . . . keeps SUPER SERVICE ahead of your most severe applications.

Result: longer cable life, fewer work stoppages, and improved safety!

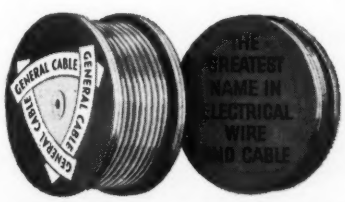
For example, the SUPERTUF neoprene jacket on new SUPER SERVICE resists sleeving, crushing, tearing, abrasion, oil and flame . . . specially reinforced for extra tensile strength.

New THERMAX heat-resistant insulation gives top protection against temporary current overloads.

Combined with extra features such as compact design to reduce sleeving of jacket from core . . . it's no wonder that SUPER SERVICE has become a byword for dependability.

In mining operations everywhere . . . day after day . . . SUPER SERVICE is keeping in check all the costliest hazards. Why settle for less? See your friendly General Cable Representative today!

GENERAL CABLE
CORPORATION



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How to make your mine safer

Here is a mine tunnel that is on its way to becoming one of the safest in the business. Reason: roof and sidewalls are ribbed with the Yieldable Mine Arch, Bethlehem's latest contribution to safety underground.

As you can see, each arch is made up of segmental sections, nested one into the other and bolted together at points of overlap. Husky U-bolt clamps make the connections tight enough to support normal loads; but under unusually heavy pressures the joints will yield to relieve the load. Thus the structural integrity of the arch is maintained, as is the safety of persons in the area.

Horizontal struts and J-bolts tie each arch to its neighbor to provide lateral rigidity in the structure. As a finishing touch, timber lagging may be used if desired, or steel lagging can be furnished. Your own men will be able to install the Yieldable Arch without special skills or constant supervision.

Perhaps the most pleasant aspect of the Yieldable Arch is a matter of economics: its reasonable first cost should be more than returned in the first year of operation. Moreover, the arch can be taken down and re-used over and over again. One of our engineers will be glad to explain it in detail at your convenience.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

COST-CUTTING MEMOS:

SPOT THE DRILL HOLES RIGHT: Drilling, drill patterns, and spacing are vital factors in reducing explosives costs. In hand steel days, each hard won hole was carefully planned to gain maximum breakage and to pull the entire length. Today, careful supervision should be employed to avoid bootlegs and poor fragmentation which result from hasty, unplanned drilling.

USE THE RIGHT SIZE CARTRIDGE: It's costly to tie up manpower arguing with stuck cartridges. Be sure you are getting the proper diameter for easy loading. In small diameter holes, take bit wear into consideration in ordering your explosives, reducing diameter of cartridge accordingly. Redi-Slit® cartridges can give both compaction and trouble free loading.

USE ENOUGH STEMMING: Large diameter holes take a lot of explosives —too much for you to write off the waste of energy which results from "blown out" shots due to insufficient stemming. Initiation with electric blasting caps at the point of maximum confinement also helps to put the explosives gases to full and profitable use in both large and small diameter holes.

COMPARE MILLISECOND DELAY RESULTS: Organized tests can show what may be achieved with millisecond delay shooting and which pattern gives best results. Check benefits not only in stoping, but also in drifts, raises, and sinking shafts. Open pit operations should compare progressive and alternate patterns. Sequence photos can show rock movement.

BETTER BLASTING is a combination of the right explosives plus the right methods. The economy and flexibility of fixed explosives in blasting operations have been firmly established. Here are a few of the many ways you can cut costs even further in both open pit and underground work . . . and aid the productivity of your loading crews. If your blasting methods haven't been checked lately, why not call your nearby Atlas representative? His suggestions may help you cut costs—and increase production, too. And write us if you'd like to receive the free, informative periodical "Better Blasting," published quarterly by Atlas to bring you technical tips and product announcements.

ATLAS

ATLAS EXPLOSIVES

"Everything for Blasting"

ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE

Offices in Principal Cities

STANOLITH MP *Grease—a single grease—lubricates all equipment at Wright Mine*

THE BOONVILLE COLLIERIES Corporation's Wright Mine uses STANOLITH MP Grease to lubricate all grease-lubricated bearings. To Wright Mine management this is good business. Using a single but multi-purpose grease, the management finds, cuts grease inventories, reduces grease dispensing equipment and, in application, eliminates costly dispensing mistakes.

Roller, ball, plain, and needle bearings are lubricated by this one grease. This applies to all mine equipment—Marion stripper, loading shovel and dragline; 7 Euclid 45-ton coal haulers; two Caterpillar D8 Bulldozers and two International Harvester tractors.

Using STANOLITH MP Grease saves Wright Mine money. It can save you money, too. Find out. In the Midwest, call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Marlin Carter, Wright Mine pit foreman (right), and Oscar Daussman, Standard Oil lubrication specialist, discuss equipment lubrication. Oscar is an old hand at providing technical service on lubrication problems. He has had more than 30 years' experience with Standard Oil, much of it working with customers on such lubrication jobs as this one at Wright Mine. Customers find this experience pays off *for them.*

STANDARD

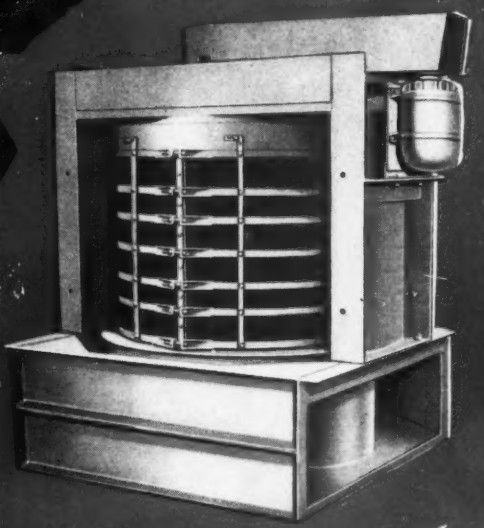
STANDARD OIL COMPANY
(Indiana)

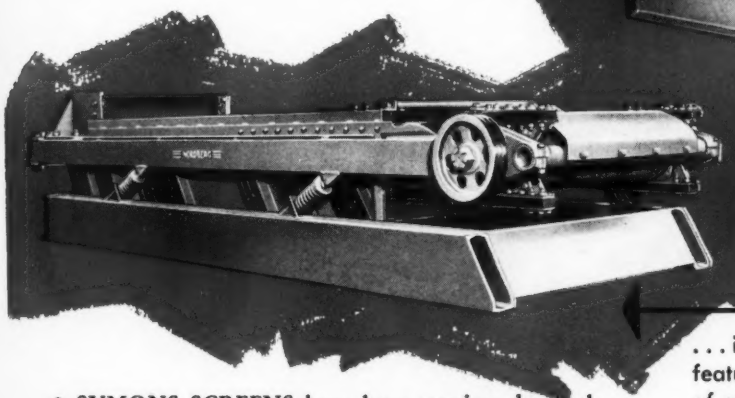
Specify SYMONS SCREENS . . .

for LOW COST
MORE EFFICIENT
Coal Preparation Service

SYMONS V-SCREENS

. . . the *only* vibrating screen that does not depend upon gravity alone to size or dewater. *By combining centrifugal force with gravity, the V-Screen does a better screening job — makes sharper separations — gives you a much dryer product with less degradation than other dewatering methods . . . and requires only 5 H.P. to operate under full load.*





SYMONS HORIZONTAL VIBRATING SCREENS

. . . in a wide range of sizes and types, all featuring: *less breakage and degradation of even the more friable coals — greater uniformity in graded sizes — wide range of separations — simple, low cost installation — low maintenance cost — easily enclosed, with entire drive mechanism outside of housing.*

• SYMONS SCREENS have been serving the coal industry for almost twenty years, in hundreds of screening applications throughout the world. These quality screens have gained an enviable reputation for dependability, efficiency and economy . . . backed by the same high standards of accuracy, design and workmanship that are used in the manufacture of *all* Nordberg Machinery.

SYMONS . . . *A REGISTERED NORDBERG TRADEMARK KNOWN THROUGHOUT THE WORLD*

NORDBERG MACHINERY

NORDBERG

SYMONS SCREENS NORDBERG

MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

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NORDBERG MFG. CO., Milwaukee, Wisconsin
Please send me further information on the following screens

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Name_____ Title_____

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 S255

"This coal **won't break up** in shipment"

AIRDOX

NON-EXPLOSIVE MINING METHOD

Cuts Costs 5 Ways

- Produces less fines in face preparation
- Rolls coal forward for faster, easier loading.
- Easier on "tender" roofs—cuts shoring, bolting
- Lowers cleaning costs by minimizing fines
- Reduces degradation—no shattered coal

That's because it was Airdox-mined. Airdox dislodges coal from the face so gently that there are no shattercracks created to cause degradation during shipment. Users get the coal size they order; shippers get an extra quality feature that boosts sales. Best of all, this modern non-explosive mining method actually cuts production costs while yielding a higher quality product.

Find out how easy and simple—and profitable—it is to use Airdox in your mine. Write for all of the important details.

CARDOX CORPORATION • **BELL BUILDING** • **CHICAGO 1, ILLINOIS**

WAREHOUSES

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Phone: Boulder
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Box 427
Phone: Library Colonial 3-6910

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NEW H-5

1/2-YD., 9-TON

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

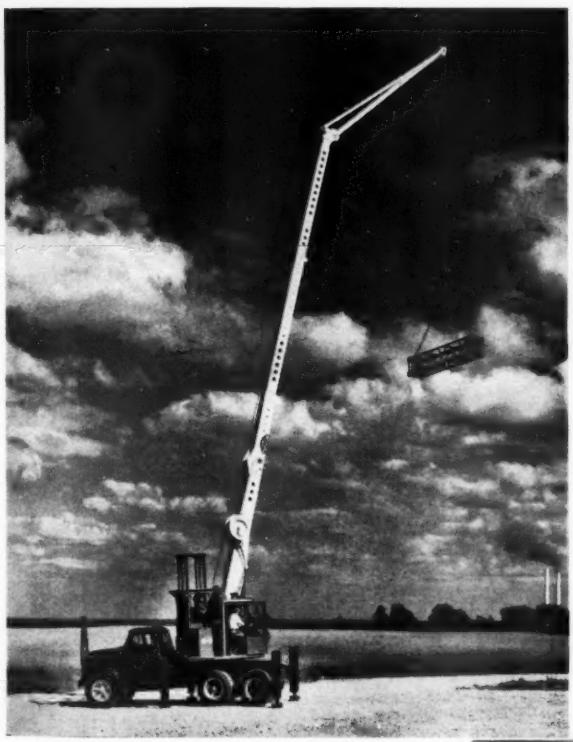
Gentlemen:
Send me your new H-5 Bulletin. This crane interests me for _____ work.
(type of job)

Name _____
Company _____
Title _____
Address _____
City _____ State _____

91H55

Hydrocrane Mounts on Conventional Truck

Completely new from outrigger feet to boom tip, this powerful 9-ton, ½-yd. Hydrocrane brings you work ability of heavy carrier-mounted cranes at small crane cost. Patented hydraulic outriggers permit mounting crane-excavator on a commercial motor truck, new or used, without sacrificing any basic crane working capacity.



Check these outstanding advantages—

Unmatched precision control of loads.

High-lift, three-piece boom (extra equipment at added cost) gives you 50 feet of reach, retracts hydraulically to 25 feet for travel. Boom and hydraulic fittings can be connected and machine working in less than ten minutes after arrival at job site.

12-ft. telescoping boom action—from 24 feet to 36 feet for standard two-piece boom, from 38 feet to 50 feet for high-lift boom, plus 20-ft. jib extension.

50-mph top highway speed.

Every work function fully hydraulic.

Up to 240-fpm line speed.

Available with clamshell, crane hook, magnet.

Optional remote truck control from crane cab.

Meets highway laws for over-all length and axle loads (depending on truck selection).

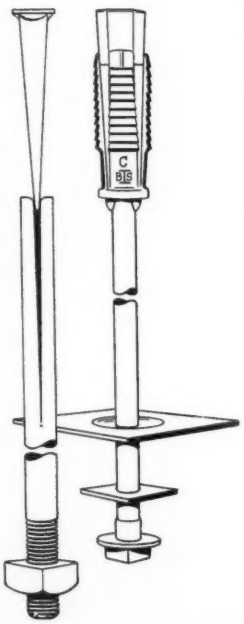
See it in action

Find out what the new H-5 Hydrocrane can do for you. Ask your Bucyrus-Erie distributor for a demonstration.

BUCYRUS-ERIE COMPANY
1880 South Milwaukee, Wisconsin **1955**
75 Years of Service to Men Who Shape the Earth

New truck, inexpensive used truck, a truck you now own—the new H-5 Hydrocrane can be mounted on any standard commercial truck you choose.

Up Goes Production... When Roof Bolts Go In



When you equip your mine with roof bolts, production is increased because of the wider openings and clearances, and increased room in which to operate mechanized equipment. And with large, old-fashioned supports out of the way, ventilation is improved.

Roof bolts make larger work area possible, and permit a tight, sound roof, because they consolidate strata into a single-unit thick beam. Such roof control promotes safety by minimizing the possibility of serious roof falls.

4 Types of Bethlehem Roof Bolts

SLOTTED BOLT. This husky 1 in. bolt has a centered slot which is made by forging, without any loss of metal. Other end of bolt has 5 in. of rolled threads. Bolt is used with steel wedge, which is forced deep into slot, expanding the bolt-ends, when bolt is driven in 1¼ in. hole. Bolt has truncated-cone point to prevent thread damage. Normally furnished with American Standard regular square nut.

SQUARE-HEAD BOLTS. Three types: a ¾ in. carbon-type, and a ⅝ in. high-strength bolt, each with typical breaking load of 24,000 lb; also a ⅞ in. high-strength bolt with typical breaking load of 45,000 lb. The ¾ in. and ⅝ in. bolts can be used with Bethlehem's matching-halves Type F expansion shell or the 4-leaf Type C expansion shell. The ⅞ in. bolt is for use with the Type F shell in 1½ in. hole.

HARDENED WASHERS. Bethlehem's hardened washer for use with headed bolts reduces the friction between bolt head and roof plate that occurs when high tension in the bolt produces excessive bearing pressure. With this washer, impact wrenches can be used freely, without galling or tearing of metal.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
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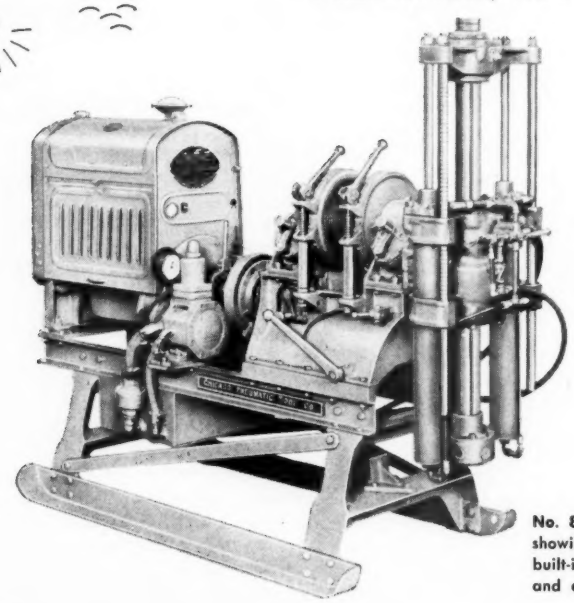
BETHLEHEM STEEL

when you get that "KICK" ...

Prove it with a CP Diamond Core Drill

Here's a sure way to get the right information on Uranium deposits. Get a CP-8 or CP-15 Diamond Core Drill. They're built for continuous operation at the high drilling speeds afforded by modern diamond coring bits. Mounted on skids, they can be readily moved from one hole to another under their own power . . . they're also available without skids for truck mounting. The mounting frame is bolted . . . can be quickly knocked down for easy transportation to remote sites. They're available with gas and diesel . . . and with both oil-hydraulic and screw-feed swivel heads. With E-EX Fittings the CP-8 has capacities to 1250 ft., the CP-15 to 2250 ft. Ask for Bulletin 313 for details on Drills and Pumps; and Bulletin 871 for information on Supplies and Operating Equipment.

Chicago Pneumatic Tool Company,
8 East 44th Street, New York 17, N. Y.



No. 8HD GASOLINE DRIVE — showing clutch, hoisting drum, built-in oil hydraulic swivel head and controls.

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Washed iron ore from concentrating plant is stocked in 42-ft. high piles by Link-Belt 115-ft. radius revolving, self-propelled belt conveyor stacker with 570-ft. long track mounted trailer belt conveyor.

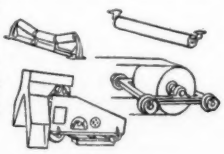
SURE ROAD TO LOWER HANDLING COSTS

. . . carry the load via Link-Belt belt conveyors

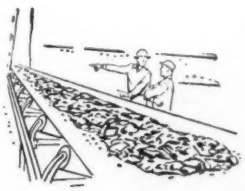
LINK-BELT offers you the "total engineering" so necessary for top efficiency

DESIGNED FOR OVERALL EFFICIENCY—Because of its unrivaled experience, Link-Belt can do a better job of gathering and analyzing all data. Proposals reflect this understanding of the most practical way to fit individual conveyors into your overall system requirements for best results.

BUILT FOR LONG-LIFE PERFORMANCE—Link-Belt manufactures all components and related feeders and conveyors. You are assured of the right equipment because of this breadth of line. And Link-Belt will supply the highest grade belts engineered to the specific job.



DELIVERS FULL RATED CAPACITY—Link-Belt follows through on every detail of the job, including electrical controls and even wiring and foundations. What's more, Link-Belt will furnish experienced erection superintendents, staffs and skilled crews at the customer's request.



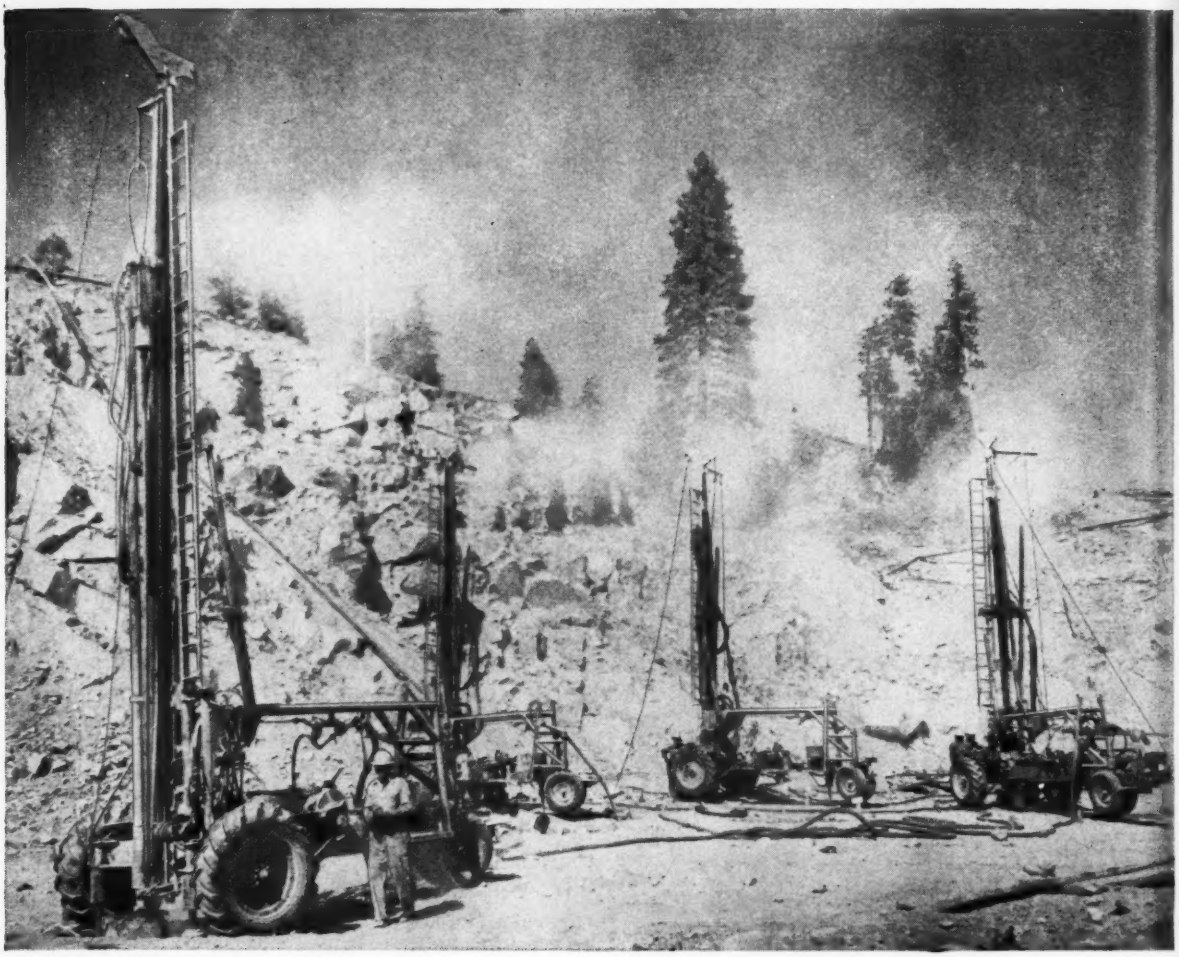
ASSURES SATISFACTORY PERFORMANCE—When you rely on Link-Belt as a single source for your complete system, we accept responsibility for placing it in full operating readiness. We will also supervise modernization of existing systems. For all the facts call your nearby Link-Belt sales representative.

13,750-B

LINK-BELT

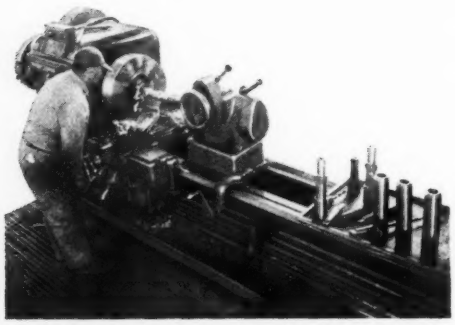
BELT CONVEYOR EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Crucible hollow drill steel at work on site of new Cherry Valley Dam.

A BIG BITE... 1½-million yards of hard granite



Machining a shank adaptor of Crucible Max-el 3½ alloy steel, for use on Joy *Challenger* drill.

That's the amount of hard rock the Guy F. Atkinson Company has now drilled through in constructing the new Cherry Valley Dam near Sonora, California.

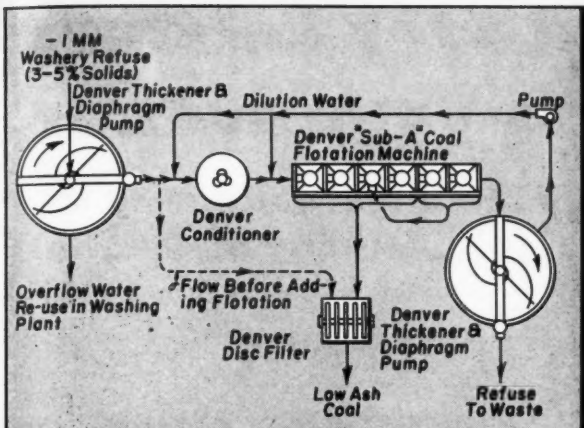
For this tough job, two-inch round Crucible *Crusca* hollow drill steel is being used in eight big Joy *Challenger* drills.

As on so many other big jobs, Crucible drill rods were chosen because experienced construction men *know* they can depend upon them for *lowest cost per foot of hole drilled* – even under the most rugged conditions. And with good reason. For Crucible hollow drill steels are made to *tool steel* standards, by the country's leading producer of tool and other special purpose steels.

Choose them for your next job. You'll get top drilling efficiency, at lowest cost. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

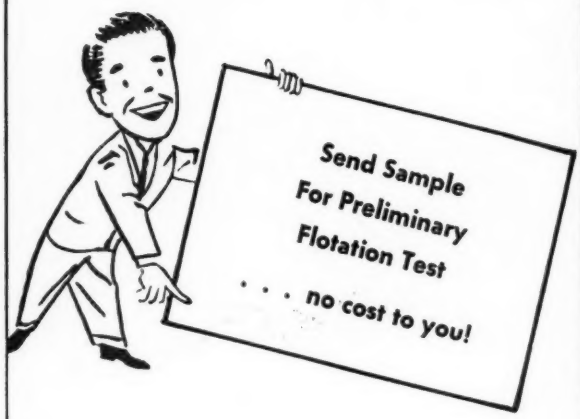
Crucible Steel Company of America

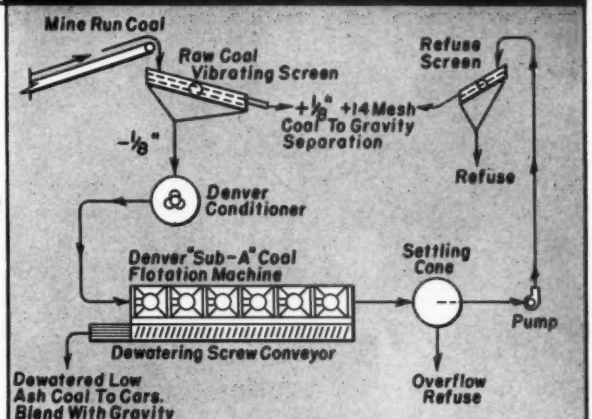


Extra Profits From Washery Refuse – Adding flotation to treat minus 1 mm coal fines, ahead of filtration, effectively lowered ash and sulphur to meet market requirements.

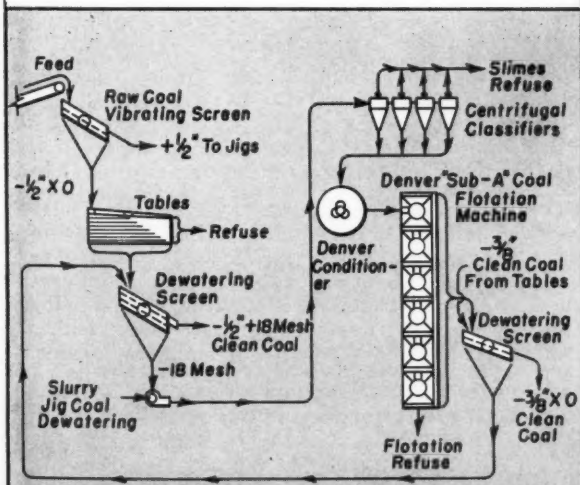
Three Simple Coal Flotation Flow Sheets

. . . How can you apply them to your plant to increase profits?





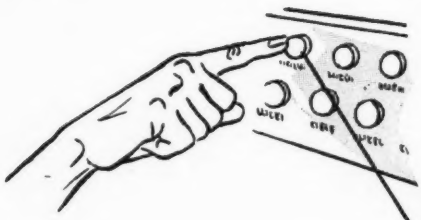
Extra Profits From Mine-Run Coal—Coarse coal fines –⅛" floated and readily dewatered in flotation circuit with inexpensive screw conveyor arrangement.

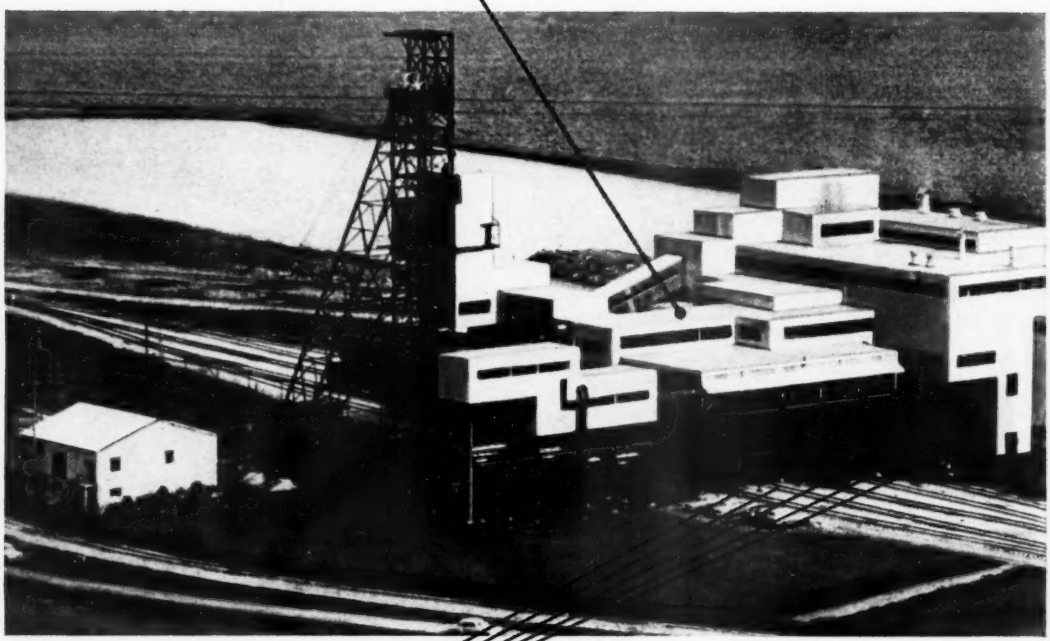


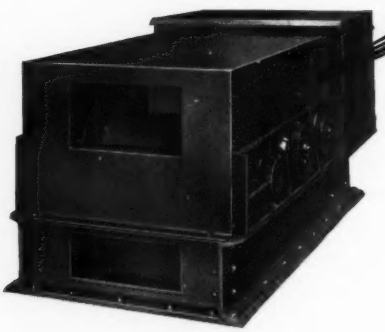
Extra Profits From Fine Coal—In this plant, flotation lowered ash to 3.5%, concentrate dewatered on vibrating screen along with coarse coal from table section.

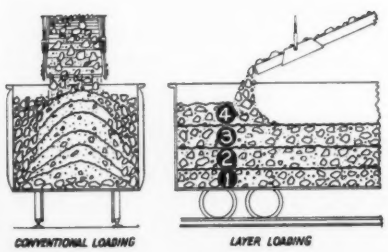
Layer Loading is your answer

. . . to more uniformity and better blending of materials









CONVENTIONAL LOADING LAYER LOADING

WITH THE PUSH-BUTTON CONTROLLED "BROWNIE" Hoist-Retarder you handle movement of cars in both directions for layer-loading.

One or several cars may be shuttled under the loading point and material loaded in layers with "BROWNIE" Hoist-Retarders. Separation of lumps and fines is reduced. There is less degradation and materials having varying chemical and physical properties may be mixed, insuring greater uniformity of product.

The "BROWNIE" Hoist-Retarder Model HKG has a 15 HP motor and is rated 12,000 lbs. rope pull at a hauling speed of 50 fpm. It can handle three 70-ton cars on a 2% grade. The model HKI is used to distribute materials in five to seven cars. It is driven by a 30 HP motor rated 24,000 lbs. rope pull hauling and 18,000 lbs. lowering at 45 fpm. A smaller model with a 7½ HP motor is also available. Ask us for more information.

Brown-Fayro Division of SANFORD-DAY IRON WORKS, INC., P. O. Box 1511. . . . Telephone 3-4191, Knoxville, Tenn.

BROWN-FAYRO DIVISION OF

SANFORD-DAY IRON WORKS

KNOXVILLE • • • TENNESSEE

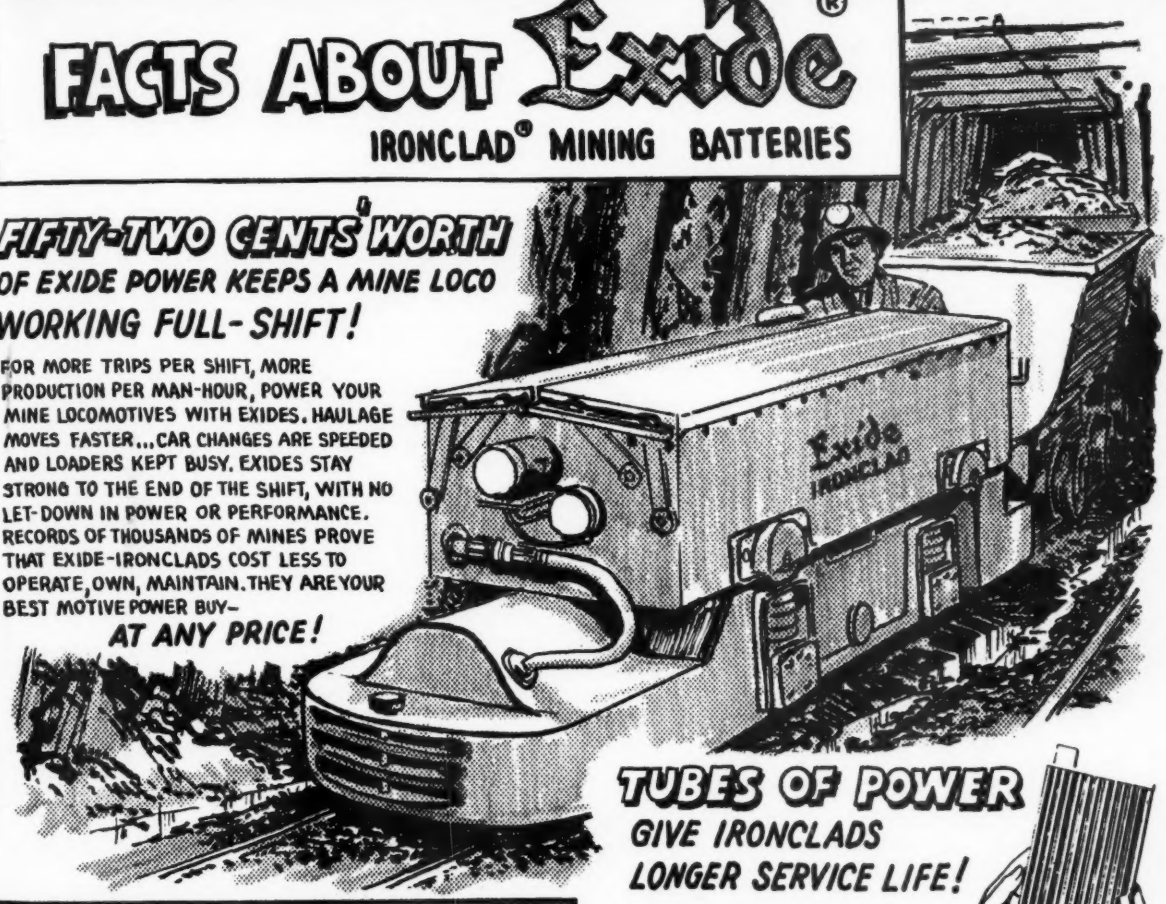
FACTS ABOUT Exide®

IRONCLAD® MINING BATTERIES

FIFTY-TWO CENTS' WORTH OF EXIDE POWER KEEPS A MINE LOCO WORKING FULL-SHIFT!

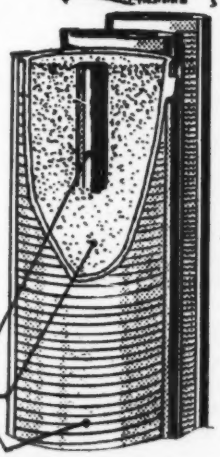
FOR MORE TRIPS PER SHIFT, MORE PRODUCTION PER MAN-HOUR, POWER YOUR MINE LOCOMOTIVES WITH EXIDES. HAULAGE MOVES FASTER...CAR CHANGES ARE SPEEDED AND LOADERS KEPT BUSY. EXIDES STAY STRONG TO THE END OF THE SHIFT, WITH NO LET-DOWN IN POWER OR PERFORMANCE. RECORDS OF THOUSANDS OF MINES PROVE THAT EXIDE-IRONCLADS COST LESS TO OPERATE, OWN, MAINTAIN. THEY ARE YOUR BEST MOTIVE POWER BUY—

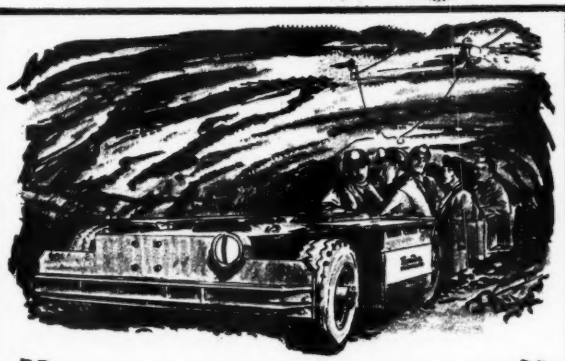
AT ANY PRICE!



TUBES OF POWER GIVE IRONCLADS LONGER SERVICE LIFE!

FINELY SLOTTED TUBES INSIDE AN IRONCLAD KEEP THE ACTIVE MATERIAL IN FIRM CONTACT WITH THE CONDUCTING GRIDS OF THE POSITIVE PLATE. THUS, THE GRID IS PROTECTED...THE ACTIVE MATERIAL IS KEPT IN CONTACT WITH THE GRID LONGER... *THE BATTERY'S WORK LIFE IS LENGTHENED.* THE SLOTTED TUBES ALSO EXPOSE MORE ACTIVE MATERIAL TO THE ELECTROLYTE... *FOR GREATER POWER!* RESULT: THE IRONCLAD'S ABILITY TO DO A DEPENDABLE JOB FOR A LONGER PERIOD OF TIME.



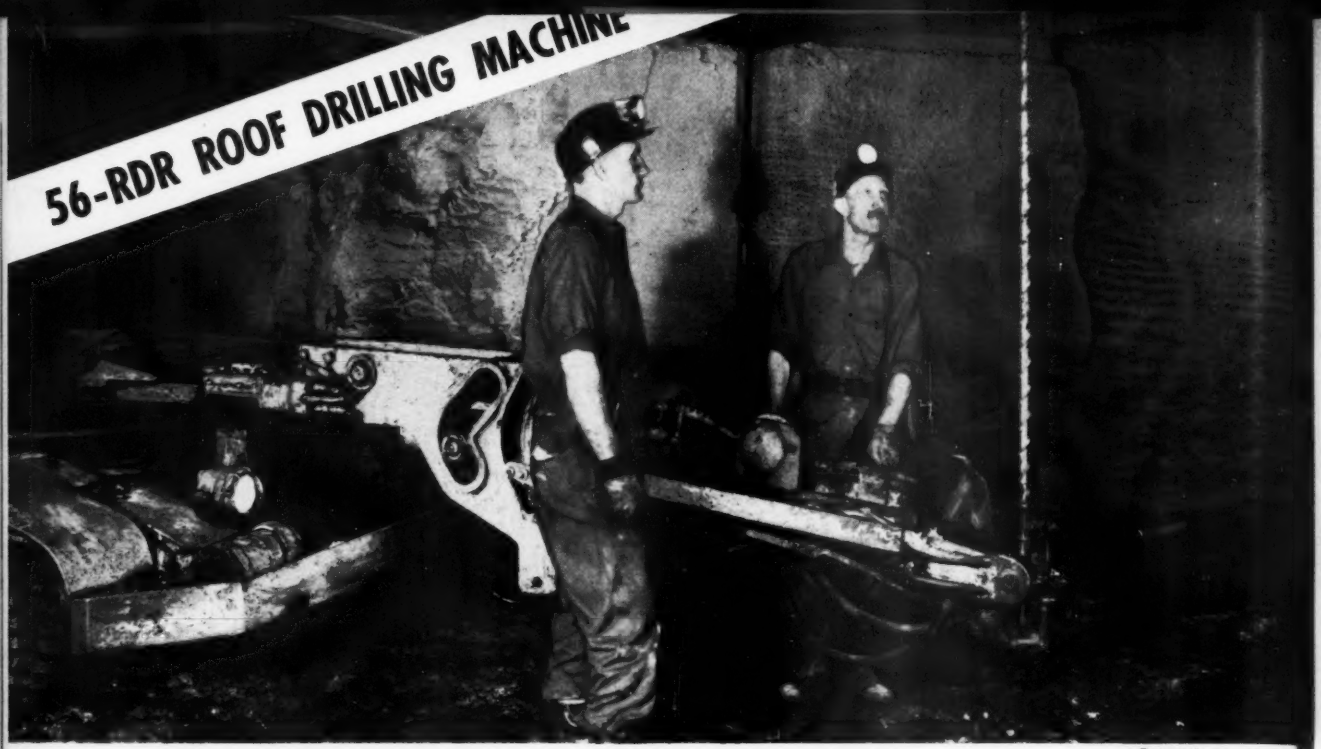


"UNDERGROUND TAXI" CUTS COSTS, BOOSTS PRODUCTION WITH EXIDE-IRONCLAD POWER!

THIS EXIDE-POWERED TRACTOR-TRAILER SPEEDS WORK CREWS, SUPPLIES AND EQUIPMENT TO PRODUCTION AREAS IN HALF THE TIME OF OTHER METHODS—WITH SAFETY, AND AT LOWEST COST. TO CUT PORTAL-TO-PORTAL TRAVEL TIME OR BOOST PRODUCTION, LET EXIDES HELP YOU. YOU'LL DO IT FASTER, BETTER, CHEAPER!

LET EXIDE HELP SOLVE YOUR MINING BATTERY PROBLEMS. ❶ CALL AN EXIDE SALES ENGINEER FOR FULL DETAILS. ❷ WRITE FOR FORM 1982, A MANUAL ON MAINTAINING MOTIVE POWER BATTERIES.

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.



Patented

fast full-time roof bolting...

It's a big, rugged, high-capacity machine for round-the-shift work. It trams fast. It can bolt a wide room from one position. The Jeffrey 56-RDR Roof Drilling machine has extra features that pay off in bigger production, lower maintenance.

This unit is especially well adapted to mines demanding a sturdy, stable machine . . . one that is expected to work a normal shift's roof drilling and bolting, plus extra places on some shifts.

Performance, like the following example, field-proves the 56-RDR's excellence: in the Pittsburgh seam, 84″ to 96″ high, a crew of two men with the 56-RDR drilled and bolted 23 working places or 138 holes 5′ deep. Besides, they drilled coal holes for shooting in 19 of these places, 4 holes per place or 76 holes 8′ deep. These were drilled with a hand-held hydraulic drill operated through a power takeoff from the 56-RDR.

Bolts ranged from 4′ to 7′, average being about 5′. Holes were drilled through 6″ to 12″ top coal . . . 1′ drawslate . . . "wild coal" varying in thickness from 2″ or 3″ to 1′ . . . "white rock" strata of clod 1′ to 3′ thick — to find anchorage in a black slate shale above.

Check these features — only three of many on the 56-RDR:

- Drill boom controls are centralized and within easy reach of the operator.
- Size and stability make unit ideal carrier for generous quantities of roof bolt materials and drill supplies.
- Cable reel of superior design pays off in extremely low cable costs over a period of years.

For additional information, write to Mining Sales Division, The Jeffrey Manufacturing Co., Columbus 16, Ohio. District Offices in Beckley, Birmingham, Chicago, Denver, Pittsburgh, Harlan, Salt Lake City.

JEFFREY

MINING • CONVEYING • PROCESSING EQUIPMENT
TRANSMISSION MACHINERY • CONTRACT MANUFACTURING

Fast and flexible operation, top picture, is aided by drill arm swing of 10′ 9½″ right or left of center. Wide room can be bolted with minimum truck maneuvering.

Besides supplies, 56-RDR pictured at right carries Jeffrey A9A Hand-Held Hydraulic Drill which operates through a power takeoff for face drilling of powder holes.

★ Mining ★
CONGRESS JOURNAL
Published for the Entire Mining Industry
by the AMERICAN MINING CONGRESS
JOHN C. FOX, Editor

Volume 41 OCTOBER, 1955 Number 10

A Showdown Is Due

DURING the first seven months of this year domestic crude oil production increased more than five percent over 1954 while imports of foreign crude increased 15 percent and foreign residual oil imports were up more than 23 percent.

In a recent letter to 18 oil companies Arthur Flemming, director of the Office of Defense Mobilization, warned that Government action may be required under the Trade Agreements Extension Act, unless they voluntarily reduce oil imports in accordance with recommendations of the President's Advisory Committee on Energy Resources. That Committee recommended last February that imports of crude and residual oils should not exceed the respective proportions that those imports bore to the production of domestic crude oil in 1954.

Statements previously received by ODM from the oil companies had indicated that no cutbacks in imports were contemplated in the months ahead.

The Trade Agreements Extension Act which became law on June 21 requires the President, in any case where he finds that a commodity is being imported in such quantities as to threaten to impair the national security, to take appropriate action to restrict such imports. In this case the President has a clear guide in the report of his Advisory Committee.

The coal industry is a bulwark of national defense. In World War I and again in World War II it was called upon to power the Nation's industrial plant when other sources of fuel could not keep up with the demand. In each case coal came to the rescue and made it possible for the United States to outproduce her enemies and win the war. In each case the industry had to pull itself out of the doldrums by its own boot straps. This took time and it is to the industry's credit that it was able to expand production quickly enough to do the job required.

Careful studies show that in order for the coal mining industry to meet another such emergency, a mobilization base of 500 million tons a year of current production is needed. Excessive imports of foreign residual fuel oil have cut into coal's markets to such an extent that, even though 1955 production will exceed 1954's output, the total will fall considerably short of this figure. A continuance of excessive oil imports will further impair the industry's ability to come quickly to the national defense.

ODM's action is a step in the right direction. It is in accord with the recommendations of the Presidential Advisory Committee and with the intent of Congress in approving the Trade Agreements Extension Act.

There has been no inkling of how the oil companies who are now exceeding the rate of imports which was found by the Cabinet Committee to be the maximum consistent with national security, will answer Dr. Flemming's warning. Perhaps a showdown is in the making. The country is waiting to see—and we are, too.

Cooperation and Progress

ON another page in this issue are given the Rules and Regulations recently issued by the Utah State Industrial Commission to cover the safety problem posed by emanations of radon gas in the mining of uranium. These regulations were formulated following a Seven States Conference held in Salt Lake City last February and meetings of uranium mine operators in Grand Junction in August. They amend the General Safety Orders for metal mines in the State of Utah and become effective January 1, 1956.

So far as is known at present, there have been no cases where uranium miners in this country have been harmed by working in an atmosphere containing radon gas, or its daughter products. In Europe there is evidence that lung cancer is more prevalent among uranium miners than among miners not exposed to these gases.

It was to look into these matters and to forestall, if possible, any occurrence of ill effects from radon that the Seven States Conference was called last February. Recommendations were made that the concentration of radioactive gases be held down in uranium mines, but the limits proposed would have been almost impossible to maintain. Thereupon the Grand Junction meeting was called. It was attended by uranium miners, manufacturers of detection equipment and State and Federal industrial health experts. Out of this meeting grew the reasonable regulations which have now been issued by the Utah Commission.

It was cooperation among down-to-earth practical mining men, scientists, medical men and State and Federal officials that resulted in a set of rules and regulations entirely practical and possible of attainment for an infant (albeit a robust) industry. Catalyst in the reaction was the Utah Mining Association. All concerned deserve high praise for resolving what might have been the death knell of the uranium industry in Utah, with sanity and with dispatch.

Out of such cooperation can come nothing but progress.

The George M. Verity with 10,000 tons of coal on the Ohio River near Manchester, Ohio

Coal on the River

River Movement of Coal Has Doubled in Last Two Decades and Is Still Growing

By GEORGE W. SALL

THERE are few of us who ever pass a coal tow on any one of the many miles of inland waterways in the United States who do not momentarily think of Huckleberry Finn and Tom Sawyer, and that sort of thing. Aside from its romantic associations, river transportation of coal is a booming business, and is growing. According to the U. S. Bureau of Mines, since 1933 the proportion of coal shipped by water, including the tonnage trucked to water, has increased from four percent of total production in 1933 to eight percent in 1953, the last year for which figures are available. In 1953 soft coal was being shipped to market over nine rivers and 35,648,000 tons of coal were moved by water that year, by far the largest single year's tonnage.

Although some of the earliest shipments of coal were by water, the major growth of this method of transportation awaited the settlement of large consumers, particularly the steel industry, on the Monongahela River near Pittsburgh. In the very recent past, the establishment on the Ohio River of large utility plants to furnish power to Atomic Energy Commission projects has further boosted water shipments of coal.

One large coal user, the Armco Steel Corp., has been using river boats and barges to move coal to its steel mills near Cincinnati, Ohio, since 1939.

Eastern terminal of the Armco Transportation Division is at Huntington, W. Va. Here coal is transferred from railroad cars to barges after making the 55-mile trip from the company's West Virginia mines. Here there also is a floating office and a floating machine shop.

The Armco coal fleet consists of three steam-powered Western River type stern-wheeled boats and 40 barges.

A Vanishing Era

Capacity of the company's rail to barge loading dock at Huntington is 400 tph. In 1954 a total of 1,200,050 tons of coal was handled through the dock. Loading facilities are flexible enough so that coal can be loaded in all but the highest water.

The *George M. Verity* is representative of the three Armco river boats. Classified as a "Towing Steamboat," the *Verity* is 162 ft long by 41 ft wide and has a draft of 5 ft. It is 43 ft high (bridge clearance) and was originally built in 1927. An oil-burning steam-powered boat, the *Verity's* compound type engines are rated as 15 by 30's with a 6.5-ft stroke. Steam is furnished to the high pressure cylinder at 250 psi. When running at full speed the special "helical" paddle wheel moves at a rate of from 15 to 16 rpm and drives a ten-barge loaded tow at a speed of four mph in still water. The wheel itself is 23 ft wide and 19 ft in diameter. There are 16 buckets or paddles on the wheel. Each is 36 in. deep. The era of steam on the river is rapidly drawing to a close. Diesel-powered screw driven towboats are taking over and it is only a matter of time until boats like the *Verity* are only a memory.

A 14-man crew operates the boat. In addition there are three women on board—a cook and two maids. The crew is divided into two watches which stand alternating six-hour turns. A watch consists of a pilot, a mate, two deck hands, an engineer, a fireman and an oiler.

For each day a crew member works on an Armco boat he gets a half day ashore. This is generally scheduled so that a man works 20 days and then takes 10 off.

Three meals, plus two lunches, plus in-between snacks is daily food routine.

Barges Hold 1000 Tons

The usual coal barge on the Ohio River measures 175 ft long by 26 ft wide by 10 ft 8 in. deep and has a capacity of 1000 tons of coal. Barge

ends are raked so that they will tend to rise out of the water instead of digging in when being pushed. Some commercial river shipping companies use larger barges but most of the coal moved on the river travels in 1000-ton capacity barges.

Fuel Barges

Some of the Armco barges have been fitted out with bunker oil tanks at one end. These fuel barges are used for supplying each towboat with oil. On the trip up the river an empty fuel barge is set off at an oil company dock to have its bunker oil tanks filled. The next boat coming up the river picks up this barge and leaves an empty fuel barge in its place. The fuel barge, which now has its bunker oil tanks filled but is empty of coal, is towed up to Huntington where it is set aside to await its turn at the coal loading boom.

After it has been loaded with coal—it now carries both coal and oil—it takes its place in a down river tow. It is handled the same as any other barge until it has been emptied at Cincinnati and is reassembled into an empty tow going up river. Now it is placed so that the oil tanks are next to the towboat. Oil is pumped from the fuel barge to bunkers on the towboat during the trip up river but before the oil company dock is reached. Here the fuel barge is again set off and a filled one picked up to replenish the fuel supply of another towboat.

A standard tow of the Armco Transportation Division is 10 barges. That is 10,000 tons of coal. The tows are arranged three barges long by three barges wide with the tenth barge placed alongside the front rank of three. These are tied together with cable and ratchet so that the ten barges are essentially rigid and can be handled as one unit. There are many different combinations possible in combining barges and boat into a tow. The governing factor is ease in handling when locking.

Setting Over

Most locks on the river are 110 ft wide by 600 ft long. This allows four 26 ft wide barges to enter a lock abreast with eight ft left over. The 600-ft lock can easily take a tow which is three barges or 525 ft long but some rearranging has to be done to get the 160-ft towboat in too. This maneuver is performed by first pushing the entire tow into the lock chamber and securing it to the lock wall with three-in. lines. Then the towboat and one barge are disconnected and set over so that the barge can be shoved alongside the second rank of three barges, behind the tenth barge. The towboat is then beside the last rank of barges which now has only two barges in it. This process, oddly enough, is called setting over.

A ten-barge tow being put together at Huntington. Note the floating office and floating machine shop in the background

Power-assisted tillers replace the old ship's wheel in the pilot house

A deck hand uses radio to keep the pilot informed of the tow's progress as it enters the lock

Pilot's eye view of the tow as he feels for the guide wall 525 ft away

Passing the time of day as tow enters Lock 33. Signs in background tell pilot river condition

In periods of high water the wicket dam in the background can be lowered and the lock bypassed

A Record

There are larger coal tows on the river than the standard ten-barge tow used by Armco. However, none has surpassed a tow handled by the steamer *Sprague*, biggest and most powerful stern-wheel towboat ever. The *Sprague* was launched in 1901 and retired in 1948. Her hull was 275 ft long and the over-all length, 318 ft. She was 68 ft 4 in. wide and her engines indicated 6990 hp at full stroke. Her record tow contained 60 coal barges and boats and measured 925 ft long by 312 ft wide, covering almost seven acres, and containing a cargo of 67,307 tons of coal. It should be pointed out that there were no locks to complicate the *Sprague's* trip with that tow.

The Dam System

Life on the river would be much easier for all concerned if there were no dams and therefore no locks, but there just isn't enough water.

In the early days of river transportation the schedule of a river tow pretty much depended on Mother Nature. There were no dams and a river captain would have to wait for a sufficient amount of rainfall to raise the river high enough to float his boat and tow past places which were ordinarily too shallow to negotiate. Locks and canals had been built as early as 1830 on the river to pass around roadblocks in the river but the present system of locks and dams on the Ohio was started in 1910 and dedicated in 1929.

Running the Open River

On the 172-mile trip between Huntington and Cincinnati there are now nine dams. There are 46 on the Ohio between Pittsburgh and Cairo, Ill., to take care of the 430 ft of drop in the river from source to mouth. The present system of locks and dams guarantees a channel with at least nine ft of water. Of the 46 dams on the Ohio, 41 are movable. Called wicket dams, they can be raised in periods of low water to guarantee the nine-ft channel or lowered in periods of high water. When the dams are up the river is in what is referred to as pool stage. Then at each dam a tow has to be locked through and lowered or raised to the next pool. When the river is high enough to assure a minimum nine-ft channel the dams, hinged to a concrete sill on the bottom of the river, are lowered, allowing a tow to pass over just as if there was no dam present. In river language this is known as running open river.

At each wicket dam there is a set of two movable dams, called "bear traps," to control the pool level when the water is not high enough to have the wickets tripped. Thus the drain off from one pool to the next can be controlled, depending on the flow of water into a pool.

Locking Through

Locking is time consuming. At best a tow can be locked through in about 20 minutes—that is if it is small enough to go through in one locking. If the tow has to be broken up and double locked, though, the time element increases considerably, and in these days of heavy river traffic it is not unusual to have several tows waiting their turn to lock through at a dam. Waits of several hours are not unheard of.

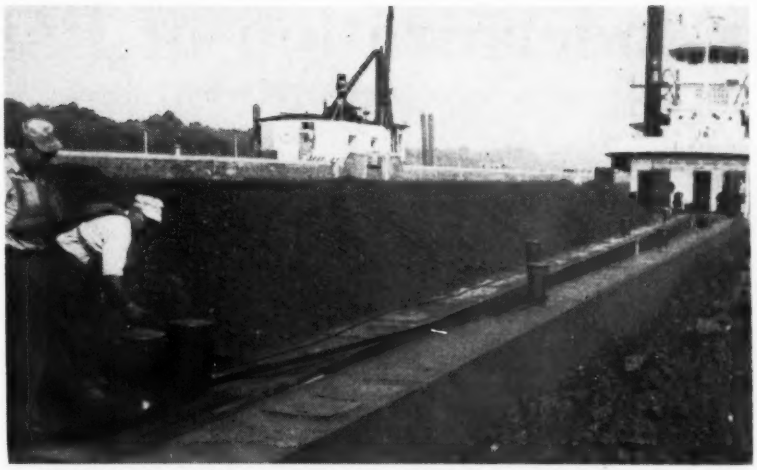
The dams and locks are the direct responsibility of the U. S. Army Engineer Corps. All vessels entering a lock are under the control of the lock tender until they are clear of the lock again and back on the open river. There is no charge for locking river craft through a dam and fishermen in small boats with outboard motors use the facilities along with commercial craft.

At each lock there is a guide wall extending 600 ft up and 600 ft down river from the lock. For all intents and purposes this is an extension of the shoreward lock wall. As a tow approaches the lock the pilot lines his tow up with the lock on this guide wall. At this time the deck crew is out on the front of the tow and one member keeps the pilot appraised of the tow's position in regard to the guide wall. The maneuver is not too difficult if the river is completely at rest. However, if some water is being run off through the "bear traps" the tow is subjected to currents which are pulling away from the lock. The strength of this pull varies, of course, depending upon how much water is running through the traps. Then the pilot is called upon to use his skill to balance the power of his boat and inertia of his tow against the pull of the river.

Big Enemy Is Weather

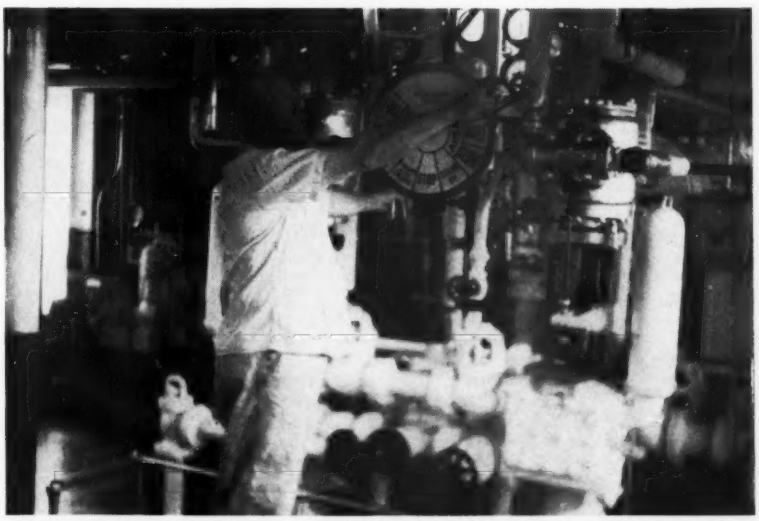
Time consumed in making the round-trip from Huntington to Cincinnati varies from 72 to 120 hours for the Armco boats. Fog and snow are the greatest perils to navigation but the recent introduction of radar on the boats has made it possible to keep on running during periods of poor visibility. If things get too tough, the pilot can always edge over to the shore and tie up until the situation improves.

So it goes, six on and six off, up and down the river. A high percentage of Armco's rivermen have roots that go deep into the history of the Ohio. Some are descended from early river navigators who floated the flat boats and the keel-boats down the river and either pulled them back or knocked them apart to sell the lumber at the down river destination. This is part of our American heritage and the present-day riverman is carrying on in the old tradition.



"Brakes" for the coal barge are a three-in. manila line and several turns around a steel timberhead

Here a lock gate is closing behind the tow which will soon be lowered six ft to the next pool level



Chief engineer complying with order from pilot signals acknowledgment over engine room telegraph

Modernization of Pandora Mill

Telluride mining district was discovered in 1875 and ore shipments began in 1877

Capacity of Former Mill Doubled and Labor Force Is Cut in Half

By F. W. McQUISTON, JR.
Newmont Mining Corporation

TELLURIDE is situated in the San Juan mining region in southwest Colorado. The region is high. Some mountain peaks rise above 14,000 ft and many above 13,000 ft.

The San Juans have yielded over $500,000,000 in gold, silver, copper, lead and zinc, or about one quarter of these metals produced in the State of Colorado. Telluride has a production of about $125,000,000, the bulk of which was produced when aggregate metal values were about one half those of current prices.

Telluride mining district was discovered in 1875, and ore shipments started in 1877. The rugged terrain from under 9000 ft at Telluride to more than 12,000 ft and long and severe winters of heavy snowfall and avalanches were quite a handicap to mining. In spite of many obstacles, the hardiness of early miners and richness of ore led to rapid development of the mines. As early as 1895, the Smuggler Union vein system was exposed along strike for four miles with production coming from a two-mile vein length.

Milling was first attempted with arrastres in 1879. Equipment and machinery were brought in by wagons, mule and burro pack trains before the railroad was built. The Smuggler Union mill at Pandora, most important in the district, was in operation in 1890. It comprised 50 stamps, Huntington grinding mills and vanners. Generation of electricity by water power at lower elevations and transmission of electricity to mills at higher elevations greatly aided mill development.

Famous mines of the district included Liberty Bell, Smuggler Union, Tomboy and Black Bear. Liberty Bell, noted for its low cost operation, over a life of 23 years produced only gold and silver, almost entirely from oxidized ore. Smuggler Union had a continuous production record of 52 years from 1876 to 1928. The Tomboy group, famous for gold, silver and lead production, closed in 1928 after 40 years' operation. Lowest ebb in production occurred in the late twenties and early thirties.

In 1940 Telluride Mines, Inc. consolidated the Smuggler Union group and Tomboy holdings and reopened these mines. This company drove the Mill Level Tunnel from Pandora, the lowest tunnel in the district.

Idarado Mining Co. acquired Telluride Mines in 1953. The Idarado mine and milling plant are located at 10,600 ft elevation, at Red Mountain, on the opposite side of the mountains from Pandora. However, the Treasury Tunnel connects the Idarado Red Mountain Mine with the mines on the Telluride side.

Ore deposits are in fissure veins of remarkable continuity in dip and strike. They are productive throughout the Tertiary volcanic flows and explosive breccias which overlie the San Juan area up to 2500 ft deep. The fissures continue down-dip through the basal Telluride conglomerate and into the sedimentary beds. To date, the conglomerate has been a fairly productive rock for ore, but the sediments have not.

Mineralogically, the ores are comparatively simple with the common sulphides, pyrite, sphalerite, galena and chalcopyrite forming the bulk of

sulphide mineralization. Gold found chiefly in the upper levels, occurs principally free. Silver is associated with both the galena and chalcopyrite.

Mining Development

Mines were originally developed from portals at 12,000 to 13,000-ft elevation in glacial basins below vein outcrops. The rugged terrain offered excellent means for tunnel entry into the veins. As the ore above was stoped out, lower level tunnels were developed at about 500-ft intervals. Life of these famous mines has been greatly prolonged by driving the Treasury Tunnel into the Black Bear and Argentine veins, the Pandora Mill Level Tunnel under the Smuggler and Montana, and the Meldrum into the Ajax and Argentine.

Present workings of the mine are accessible through the Mill Level Tunnel at elevation 9070, and the Meldrum Tunnel, which is capable of grade connection with the Camp Bird lowest level, at an elevation of slightly under 10,000 ft. These levels, together with the Penn Level at elevation 10,300 and Treasury Tunnel at elevation 10,600, constitute the main haulage levels of the mine.

Broken ore from the mining levels tributary to the Pandora plant is drawn out at Mill Level through a series of ore passes, some of which are over 1200 ft long on the dip of the vein. Service to upper levels is through two 1200-ft service raises, one at the north end of the mine and the other at the south end. To make these facilities available, ore passes, service raises, haulage drifts and crosscuts, which total over 3000 ft of raising and 6500 ft of drifting, were accomplished within the past year.

As broken ore reserves were limited, the production of 30,000 tons per month imposed quite a problem. This means that under the adopted system of slusher drift shrinkage stoping, at least 70,000 tons of ore will be broken per month in order to draw the required 30,000 tons. However, once additional stopes have passed from mining cycle to draw cycle, the ore breakage figure will be considerably reduced.

Greater part of the ore is derived from a 2000-ft long block of stoping ground on the Meldrum Level. To service this with air, water, ventilation and supplies, the block has been broken down into eight stopes, each is operated with a crew of four men on each of two shifts. Three men on each shift are machine men and one is a slusher operator.

Additional tonnage to feed the mill is derived from other scattered stopes, development work and leaser ore from the north end of the mine. It is expected that by the end of the second quarter of 1956, there will be broken ore reserves sufficient to relieve the pressure on the mine department.

Milling

Pandora mill, two miles east of Telluride is located in a box canyon at the junction of Marshall Creek and the San Miguel River. On three sides cliffs rise abruptly 1000 ft. Two waterfalls, Cascade and Bridal Veil, falling 370 ft, feed San Miguel River.

Pandora has been the site of milling operations since the first stamp mill in 1890. In 1920, the present mill building was erected, and ore was transported to the mill by aerial tramways from Black Bear and Smuggler Union mines. This mill building has been the home of several mill enterprises. In 1940, Telluride Mines installed a new flotation plant, which was the first effort made in the district to recover zinc. When Idarado took over the operation in 1953, mill capacity was raised to 800 tpd. It soon became apparent mill capacity was insufficient and recoveries were not satisfactory. For these low grade ores to be profitable, the operation had to be modernized to obtain better metallurgy and lower operating costs. During the decline of metal prices in 1954, plans were made to rebuild the mill and increase capacity.

Planning for Mill Capacity

Mine operation is planned for a five-day work week, with mine haulage at the rate of 100 tph, seven hours per shift, two shifts per day. These factors formed the basis for mill planning. Milling capacity for 30,000 tons per month, with provisions for future expansion to 40,000 tons, was the established prerequisite.

Detailed studies for increasing the milling rate from the existing 800 tpd to the required 30,000 tons per month showed the scheme giving greatest dollar yield would be to install capacity for 1400 tpd. Increasing capacity 75 percent was a radical departure from the usual course followed of raising a milling rate from 800 to 1000 tons, or 25 percent. A combination of many factors influenced this decision.

Grinding Is the Bottleneck

The old milling plant comprised crushing in three stages to ⅜-in. Due to wet, sticky nature of ore, the plant had difficulty maintaining a 50 tph rate. Fine ore storage was 2000 live tons, and grinding units were 8 by 6 and 7 by 6 ball mills. Flotation consisted of two parallel lead and zinc circuits. To increase the milling rate to 1000 tpd required more bin storage, operation of crushing plant on a three-shift basis, or a new plant plus more grinding equipment.

Additional coarse ore storage could not be obtained without a costly installation, as elevation of haulage track and mill ground level only allowed for construction of long narrow bins. The coarse ore would have to be conveyed a considerable distance, which was a poor arrangement. An alternative plan was to increase crushing rate to 100 tph to keep pace with mine haulage. Crushing to ⅜-in. requires removal of wet fines ahead of the secondary crushers. This complicated the flow scheme and added to costs. However, the major technical problem in planning expansion revolved around grinding capacity.

Rod Mill the Answer

Many years' experience at Idarado in milling ores from Black Bear and Argentine veins had established certain grinding factors. These data, when related to grindability of ores from Tomboy, Smuggler Union, Ajax and Montana veins, which will contribute feed to the new mill, proved more grinding capacity was essential. Two schemes could achieve this: (1) finer feed to ball mills; (2) install more ball mill capacity. Crushing finer than ⅜ in. was impractical; however, a rod mill installation appeared very favorable. Adding a third ball mill or replacing a mill with one larger would result in costs similar to a rod mill installation. A rod mill offered the following advantages:

(1) Allows for ¾- to 1-in. crusher product thereby simplifying the problem of crushing sticky ore.

(2) Facilities feeding from fine ore bins.

(3) Permits more flexibility between crushing and grinding.

(4) Gives more efficient free gold recovery from jigging rod mill discharge.

(5) Reduces kwh consumption per ton of ore milled.

(6) Increases ball mill efficiency through use of smaller balls.

Having decided a rod mill was the more efficient way to increase capacity, it was then necessary to select the correct size. Rod mill size calculations were based on grinding a feed of ¾- to one-in. to 8-10 mesh. This was established as the size of feed and discharge to give highest rod mill efficiency. Several rod-ball mill combinations were considered for grinding 1000 tpd. A scheme to use the two existing ball mills called for a rod mill too small in size for good efficiency. The 8 by 6 ball mill alone did not have enough capacity on 10-mesh feed.

Check Efficiency

Based on the assumption that highest milling efficiency is obtained with power consumption distributed 30 percent and 70 percent between rod and ball mills, it was decided to use both ball mills in combination with the correct size rod mill. Manufacturers' recommendations varied widely for power requirements to grind one-in. ore to 65 percent minus 200 mesh.

However, a series of calculations related to known grinding factors on Telluride-Idarado ores defined the required kilowatt hours per ton, which in turn specified a certain motor and rod mill size. The rod mill and two ball mill combination giving greatest power and steel efficiency, fell between 1400 and 1500 tpd, which matched the mine haulage rate.

To check on grinding efficiency at a 1400-tpd rate, several crushing schemes were investigated. These included both three and two stages at different rates. Construction costs for three-stage crushing to ⅜-in. at 120 tph rate was 30 percent more than a two-stage plant to one in. This cost differential about covered installation costs for a rod mill, which proved the validity of evidence in favor of rehabilitating the mill for 1400-tpd capacity.

Inadequacy of existing classifiers led to the problem of whether to use cyclones or classifiers. Capital and operating costs were estimated for six separate classification schemes. The most favorable appeared to be a single classifier in closed circuit with two ball mills. In this scheme, the classifier making a 28-mesh split would be operated in series with a cyclone giving a finished 65-mesh flotation feed. The object was to combine advantages of both the classifier and cyclone. Returning to the ball mill tramp iron and coarse sands with a classifier appears to be more economical than pumping the entire ball mill discharge to a cyclone. Pumping minus 28-mesh classifier overflow with oversize material and tramp iron removed, eliminates severe abrasion and reduces power consumption. A combined classifier cyclone installation calls for low expenditure and operating costs.

Flowsheet Described

The crushing plant is designed for one-man operation, when crushing 120 tph from 16-in. to ¾-in. It is laid out for complete vision of all equipment units from an operating deck at the feeder belt. The secondary crusher will operate in closed circuit with a screen to assure uniform rod mill feed. With exception of the coarse ore bin feeders, the plant will comprise new equipment and a new building.

A third fine ore bin is planned, not for ore storage purposes, but to obtain maximum blending of mill feed. In this scheme one bin is filled at a time, but the draw is continuous from all three bins. Ore will discharge through a tapered slot the length of the bin bottom, onto variable speed conveyors. This method of bin draw prevents "chimneying," gives more uniform size blending of bin discharge and has proved most effective on a sticky ore.

Rod mill feed passes over a conveyor scale connected to an automatic tonnage recorder and regulator. Mill discharge flows by gravity over an iron trap and jig for recovery of free gold, then to a single classifier in closed circuit with the two ball mills. To close the ball mill circuits, classifier sands are returned to the scoop box by conveyors. Overflow from either cyclone or classifier, whichever classification practice yields the best metallurgy, is by gravity to the copper-lead flotation circuit.

To streamline flotation, the two 500 and 300-ton lead and zinc circuits were replaced with single 1400-ton circuits. Each consists of 12 rougher and 12 scavenger cells. Rougher concentrate will be double-cleaned. Cleaning capacity was based on tons overflowing per lineal foot of froth wier to assure maximum grade of concentrate. The joint lead-copper concentrate is separated into individual lead and copper products in a third flotation circuit. Two different methods, centrifugal pumps and pumper cells, are used for handling flotation products. Each method is tailored to the particular problem of elevating. Higher lifts will be by centrifugal pumps. Pumper cells are used where closures require low lifts.

The pH of both lead-copper and zinc flotation circuits are automatically controlled by lime slurry proportioning pumps actuated from a pneumatic rheostat built into the pH indicator.

Flotation concentrates are pumped to cyclones located above their respective filters, with the underflow filtered directly. Cyclone overflow is thickened before being returned to the filter. This practice gives a lower moisture filter cake and reduces thickener area required per ton of initial concentrate. The use of cyclones in combination with the newly developed flocculants reduced thickener area by about 50 percent.

Filters are located above the storage bins and discharge directly into rectangular concrete bins with one open end. A truck passage runs under the bins. Truck loading is by a scraper with the hoist mounted on a turntable to serve all three bins. This method of discharging concentrates from bins to trucks has proved most effective. Concentrates will be transported by 20-ton truck to the railhead, a distance of 67 miles for shipment to Leadville, El Paso and Amarillo.

Construction

The mill was completely stripped with exception of the two ball mills. All usable equipment was overhauled, sandblasted and repainted. Cranes and hoists were installed first to facilitate handling equipment.

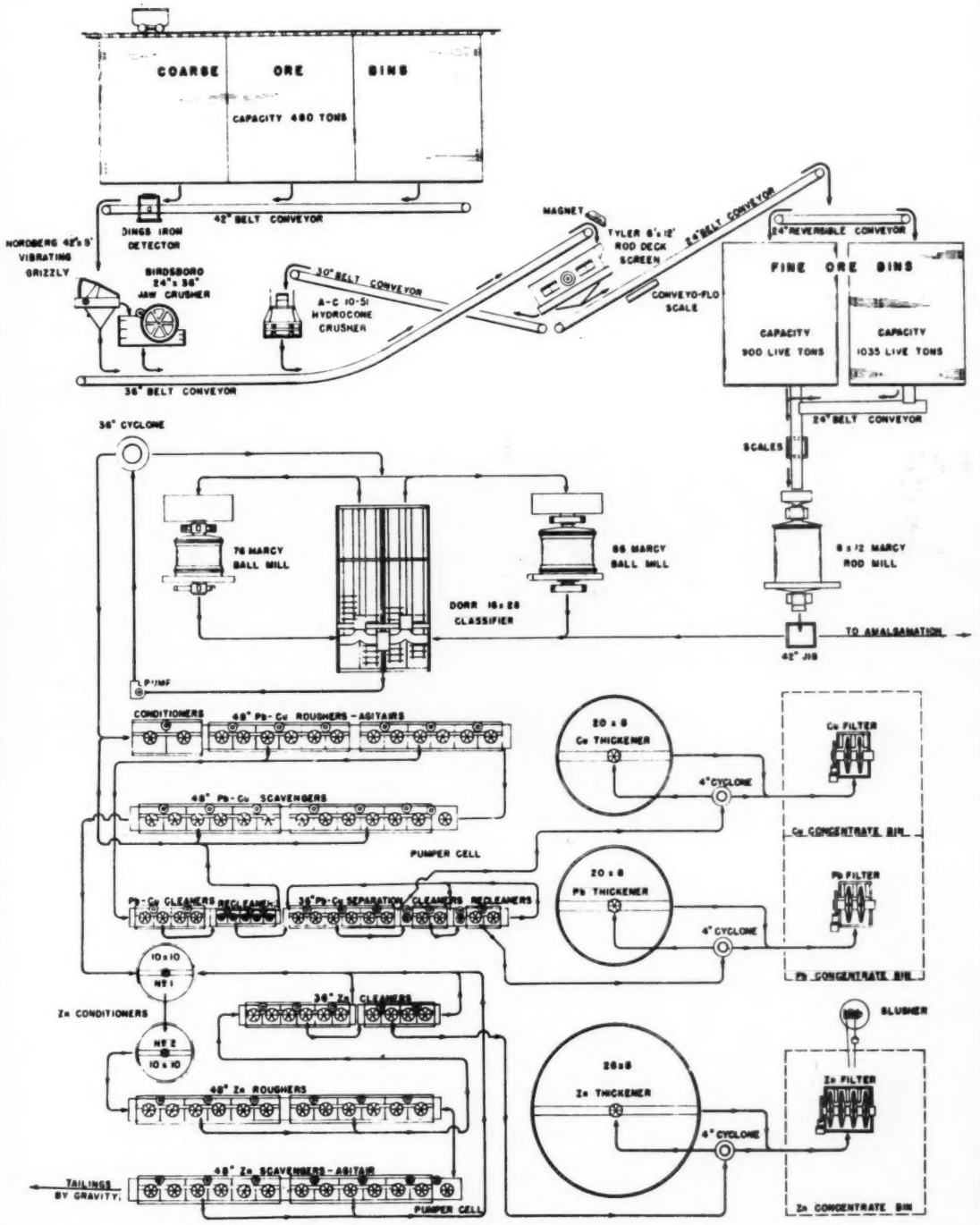
The mill service floor is a concrete slab at ground level with 10 percent slope for drainage. Spillage, separated by curbs, can be flushed to different sump pumps and returned to the correct circuit. All pumps are located on this floor. Four-inch pipe columns are used for supporting flotation equipment on the floor above. For lowest initial cost and more convenient operation, the flotation operating floor is on one level.

Above the flotation floor is the reagent warehouse capable of storing 20 carloads of reagents. A fork lift truck will be used to distribute reagents from storage to mixing tanks located on the same floor level. Reagent storage, mixing and distribution are designed for a labor requirement of one man per day. Reagents in solution or as a slurry will floor by gravity from the mixing tanks to a centralized distribution center.

A 20-ton electric traveling crane services the rod and ball mills. Track-mounted electric hoists are available for all flotation equipment and pumps. A grinding ball storage bin discharges

Idarado mine and mill are at Red Mountain across the mountains from Pandora

PANDORA MILL – 1400 TONS PER DAY



into a track-mounted car where balls are weighed before charging.

A single building, covering approximately 30,000 sq ft of ground area, 3½ floors high, houses the concentrator, warehouse, shops, compressors and mine change room with space available for the general offices. It is an all-steel galvanized iron building.

The office and metallurgical testing laboratory are located at an elevation for unobstructed observation of the flotation and grinding floor.

TABLE I

Point of Addition	Reagents	Lbs/Ton
Grinding mills	Lime pH 9.0	3.0
	Zinc Sulphate	1.25
	Sodium Sulphite	0.60
	Sodium Cyanide	0.075
	Cyanamid 404	0.035
Classifier pool	Potassium Ethyl Xanthate	0.04
Copper-Lead separation	Zinc-Cyanide	0.40
Zinc Conditioner No. 1	Copper Sulphate	0.60
Conditioner No. 2	Potassium Ethyl Xanthate	0.02
	Lime pH 11.5	2.50
Scavengers	Potassium Ethyl Xanthate	0.02
Total Frother	MIBC	0.10

Tailings Piped to Dam

Tailings disposal is patterned after the Idarado method where the mill tailings flow a distance of 16,000 ft to storage at an elevation 800 ft lower. Pandora tailings flow by gravity 8000 ft to the dam 200 ft below. The pipe is nine-in. fir wood stave with a wall thickness of 1¾ in. The pipe will ultimately wear to 10½-in. diameter, at which point it will act as a flume. The pipe line is laid on a one-percent grade to insure minimum pipe wear even though a 1.3 percent total grade is theoretically needed for gravity flow. Additional gradient of 0.50 percent is developed by drop boxes located at strategic intervals thereby allowing a total of 1.5 percent over-all grade.

The Treasury Tunnel connects Idarado's Red Mountain Mines with mines on the Telluride side

The storage dam is 3300 ft long, 60 ft wide at the base, and 14 ft across the top, with an average height of 15 ft. It is built of gravel to insure porosity. No subsoil drainage is required because the 40-acre area is located on a diverted river bed.

A sand-slime separation is made at the end of the pipe line with a wooden spetzkasten. The slimes are deposited behind a low inner dam located 200 ft inside the berm. This practice of depositing sands and slimes separately is used only in the initial stages of filling to keep the slimes back from the face.

Tailings will flow by gravity through the existing pipe line for nine-year storage. For the first five years no regular labor is required for attendance. The dam is inspected daily by one of the mill crew. Tailing disposal costs are set up at three cents per ton including amortization of the pipe line and construction of the dam.

Electric Power Purchased

One of the unique features of the Pandora operation is the power supply. Power for both Idarado operations is purchased from the main 44,000 volt line of the utility company at the Treasury Tunnel, Red Mountain. It is transmitted from Red Mountain at 12,470 volts by four miles of underground cable through the Treasury Tunnel, down an 800-ft raise, and out the other side of the mountain through the Meldrum Tunnel. From the portal it is transmitted 4200 ft by overhead line to the main substation at Pandora. The reasons for this feeder system were to gain a single meter billing for both operations, to acquire reserve capacity underground, and also because the utility company could not guarantee adequate and reliable power at Telluride for mill operation.

The main power transformer and all control and switchgear equipment, with exception of push button starters, are located in pressurized control rooms in the mill and crushing plant. The rooms are forced ventilated by filtered air at a pressure above atmosphere to maintain dust-proof conditions. In the design of the electrical system, every effort was made to utilize the latest types of equipment that would reduce erection and maintenance costs.

The main underground cable is tapped at three points for distribution to mine working areas at 4160 v. The whole transmission system is protected by coordinated circuit breakers to isolate faults.

The first industrial line in the United States using high voltage alternating current for transmitting power over a considerable distance was constructed near Telluride in 1890. It is rather interesting to compare this with the present method of transmitting power through the mountains rather than over them.

Mill Operation

The Telluride operation is under the supervision of Idarado department heads. The distance by road from the Idarado Red Mountain operation to Pandora is 67 miles and requires almost two hours of driving time. The distance underground from the portal of the Treasury to the portal of the Mill Level Tunnel is about 5.5 miles. The two operations are closely linked by an underground communication system of dial telephones.

A labor force of 18 men will be required for the operation. Distribution is as follows:

	Total	Per Shift
Mill Foreman	1	
Shift Bosses	3	1
Crushing	2	1
Grinding	3	1
Flotation	3	1
Amalgamation	1	
Reagents	1	
Mechanical	2*	
Loading Concentrates—Cleanup	2	1
	18	5

* One man on mill payroll—5 shop men one day when mill is shut down.

Distribution of direct operating costs are as follows:

Labor	15.6 percent	
Reagents	14.8 percent	
Supplies	54.7 percent	
Power	14.9 percent	(Consumption at 20.5 kwh per ton)

Approximate reagent consumptions are shown in Table I.

(Continued on page 78)

Processing Fine Coal For Competitive Fuel Markets

Blue Diamond Washing 80 Tph of Minus ¼-in. Coal at Its Leatherwood No. 2 Cleaning Plant to Maintain High Degree of Uniformity in Final Product

By J. D. SNYDER and J. E. TOBEY, JR.*
Mining Engineer Industrial Engineer
Blue Diamond Coal Co.

IN THE FACE of the post-war pattern of diminishing markets, descending prices and rising labor and supply costs, the coal producer who would expand his scope of operations has found it increasingly difficult to invest his capital so that it will yield the greatest possible return. During the past eight years or so, any company pursuing a program of developing new operations or expanding old ones has had to face the fact that the productive capacity of the coal industry is so much greater than the demand for coal that there is no waiting market capable of absorbing additional tonnages from new and expanded operations.

Furthermore, and this is particularly true with respect to the "old-line" producers of southern bituminous coals, it has been necessary to shift the emphasis in both production and merchandising from the domestic to the industrial and commercial markets. In brief, this means simply that the producer placing new tonnage on the already overcrowded market must be in a position to offer a competitively-priced product sufficiently high in quality to displace other coals, mainly from industrial and commercial plants. Under these circumstances, the problem of fine coal cleaning assumes a great deal of importance. Factors such as market acceptability of the coal, realization, recovery, initial investment in equipment, and cost of operation must be very carefully weighed in determining if, and to what extent, fine coal is to be cleaned at a particular operation.

There are obvious economic advantages in the not uncommon practice of cleaning, for example, the plus ¼ or plus ⅜-in. coal, up to some selected top size, and loading uncleaned fine coal, either separately or blended, back with the washed nut sizes. Where the amount of fine coal in the raw feed to a cleaning plant is relatively small and the ash content sufficiently low that a satisfactory realization can be obtained on both the fine coal alone and on the blended preparations, there is little incentive for extensive processing of the fine coal. A number of operators, although not blessed with low-ash fines, have apparently found it economically feasible to dispose of uncleaned fine coal as a secondary product at extremely low price levels. If the realization obtained on the coarse sizes from such operations is high enough to offset the poor return on the fine coal, this expedient is, of course, perfectly practical. Unfortunately, or very possibly, fortunately, neither of the above methods of handling fine coal seemed to offer much promise as a satisfactory solution to the fine coal problem in connection with Blue Diamond's Leatherwood operations.

Market Changes After 1945

Prior to World War II, the preparation of fine coal did not involve any major problems insofar as the Blue Diamond Coal Co. was concerned. All of the coals produced by the company were of premium grade and were mined from clean seams. Through careful selective mining and loading methods, carbon coals loaded at such operations were low in ash and did not differ materially in quality from the other sizes produced. By far the bulk of the fine coal produced was marketed as nut and slack, commercial stoker, and resultant run-of-mine. Only those mines producing domestic stoker coal loaded significant tonnages of carbon coal and, as stated above, such carbon coal was of a quality which rendered unnecessary any form of mechanical cleaning.

This picture underwent a radical change when, in 1945, Blue Diamond initiated the development of the Leatherwood seam, located in Perry, Leslie, Letcher and Harlan Counties in Eastern Kentucky. In developing this seam, it was the intent of the Blue Diamond Co. to build an operation capable of producing several million tons per year. On the basis of the then current and predicted production costs, it was quite apparent that such an operation would have to be completely mechanized in order to be economically feasible. Furthermore, it was anticipated that market acceptance of such a large tonnage could be obtained only by offering to the consumer a product which would be competitive in price and superior in quality and preparation to most of the coals normally available.

Since the analysis and burning characteristics of the coal indicated that it would be particularly desirable as an industrial and commercial fuel, it was further anticipated that some 60 to 70 percent of the Leatherwood production would be directed to that market. In view of this, prime consideration was given to the question of processing the fine sizes. A brief reference to the principal industrial and commercial preparations currently loaded at Blue Diamond's Leatherwood operation will serve to substantiate the existence of a real need for a high-quality carbon product.

In the first place, large tonnages of double-screened nut coal and modified nut and slack are regularly loaded which, in turn, means a regular production of carbon coal for which substantial, reliable outlets are a necessity. Since a large part of the carbon coal is sold to public utility generating plants which, as a rule, base their purchases upon some modification of the "cents per million btu" formula, uniformly high quality is essential if regular shipments at satisfactory price levels are to be maintained.

In the second place, all of the industrial and commercial preparations loaded at Leatherwood are blended, with the percentage of ¼-in. by 0 fines varying from as little as 5 percent to as much as 50 percent, depending upon the specific requirements of each individual customer. In most industrial plants, and particularly in those equipped with underfeed burning equipment, the free-burning Leatherwood coal performs most efficiently in preparations containing from 18 to 40 percent ¼-in. by 0 fines. This is, of course, contrary to experience with coals having stronger caking tendencies. To insure uniformity in the quality of preparations which may vary so greatly in size consist, it is imperative that the ¼ by 0 fines be of a

* Since the completion of this article Mr. Tobey has joined the Indiana Coal Association as director of engineering.

quality comparable to that of the coarser sizes.

In July 1950, a 700 tph cleaning and preparation plant, designed and built by Roberts and Schaefer, was placed in operation at the Leatherwood No. 1 Mine. Detailed information concerning the design and operaton of that plant has appeared in other literature, consequently no attempt will be made here to describe it beyond the few words necessary to permit several pertinent comparisons with the newer Leatherwood No. 2 plant.

Briefly, in the No. 1 plant, the plus 8-in. coal is hand-picked and the raw 8-in. by 0 coal is washed in a three-compartment, eight-cell Jeffrey Baum Jig. It may be of interest to note in passing that this jig, at the time of its installation, was not only the largest of its kind but was handling the widest size range in contemporary jigging practice. The ¼-in. by 0 coal is accumulated in a conventional drag tank, wet-screened at 48 mesh on Allis-Chalmers "Lo-Head" vibrators, mechanically dewatered in Bird centrifugal filters, and thermally dried in a Combustion Engineering "Raymond" flash dryer. Water clarification is accomplished with Bird centrifugal filters and no attempt is made to recover coal smaller than 48 mesh in size.

No. 2 Plant Has A Special Design

In October of 1954, a second Leatherwood cleaning plant, this one designed and erected by McNally-Pittsburg, was placed in operation at the No. 2 mine. This plant employs two McNally-Tromp dense-media (magnetite) washers for cleaning the lump (14 by 2-in.) and small (26¼-in.) sizes and Deister diagonal-deck concentrating tables for cleaning the fine (¼-in. by 0) coal. Since both of the Leatherwood Mines operate in the same seam of coal it might, at first, appear strange that the two plants should employ totally different washing circuits, particularly in view of the highly satisfactory performance of the No. 1 plant. It is, therefore, pertinent to resolve any questions on that score before undertaking a description of the No. 2 plant. Although the prepared coal, as loaded into railroad cars, is analytically the same at each of the two mines, there are substantial differences in seam conditions which account for the fact that a different washing circuit was selected for the No. 2 mine.

Comparisons of representative seam sections from each of the Leatherwood Mines, figure 1, indicates the extent of the difference in the cleaning problem on coal from the two mines. The parting of high-ash, middle-gravity rash near the bottom of the seam in the No. 2 mine, which must necessarily be mined with the coal, presents a very difficult cleaning problem. Because this rash is of a soft, friable nature, the greater part of it is concentrated in the small and fine sizes. Furthermore, the fracture characteristics of the rash are such that small particles are flat, having a conformation best described as "discus-shaped." These two factors combine to make it particularly difficult to clean the small and fine sizes efficiently.

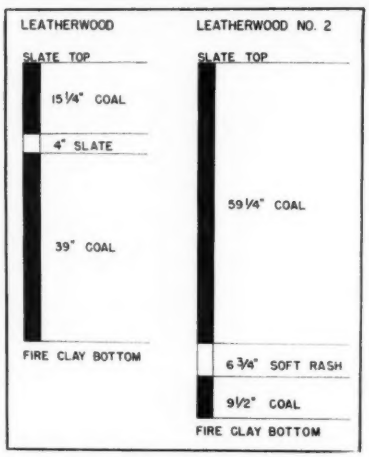


Fig. 1. Typical sections from the two Leatherwood mines

While it would no doubt be possible to clean the No. 2 coal by jigging, as in the No. 1 plant, complete separation of the rash would be quite difficult and economically unfavorable. Ample evidence of this was provided during the period 1950-1954 when the 5-in. by 0 coal from the No. 2 mine was regularly transported by rail to the No. 1 mine and processed through the cleaning plant there. Although this practice proved very satisfactory as an interim solution to the problem of cleaning the No. 2 coal, it did not permit operation of the No. 1 plant at maximum efficiency. The jig settings necessary to accommodate the No. 2 coal adversely affected the recovery of the more easily cleaned coal from the No. 1 mine. This situation was further aggravated by the distortion in size consist of the feed to the jig which resulted from the introduction of the Leatherwood No. 2 5-in. by 0 material. Since the greater part of the tonnage processed through the cleaning plant was from the No. 1 mine, the loss of clean coal to refuse was excessive under these conditions. This loss, together with the additional cost involved in transporting the No. 2 coal by rail to the cleaning plant, made it uneconomical to continue permanently on that basis.

It would have been possible, of course, to install additional washing equipment in the No. 1 plant to ac-

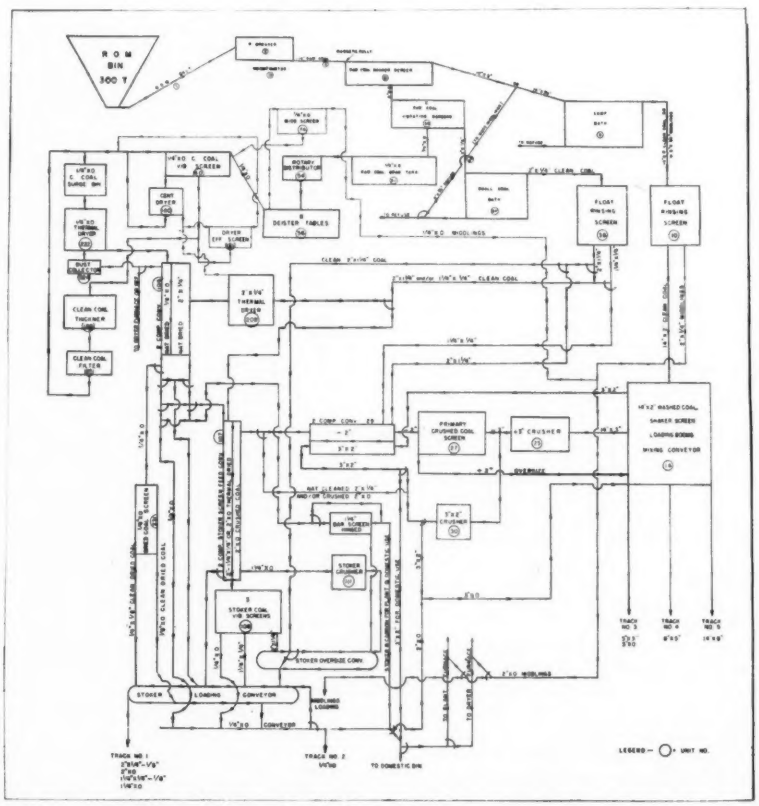


Fig. 2. Flow diagram showing the major preparation equipment at the Leatherwood No. 2 mine

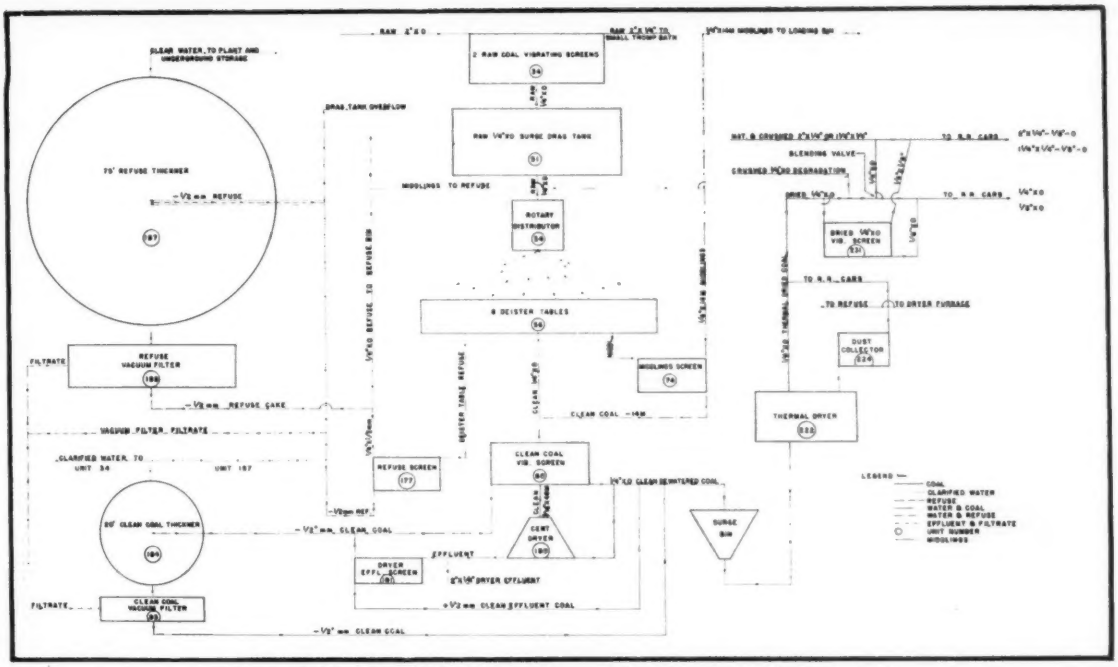


Fig. 3. Detailed flowsheet of the Leatherwood No. 2 fine coal and refuse circuit

commodate the No. 2 coal, and some consideration was given to this expedient. The idea was rejected, however, partly because it would have done nothing to eliminate the cost of transportation between the two mines, and partly because the projected tonnage of the No. 2 operation would have necessitated substantial increases in the capacity of virtually all of the other circuits in the No. 1 plant. It was, therefore, mainly upon the basis of the foregoing considerations that the specifications for the Leatherwood No. 2 cleaning plant were decided upon.

General Features of the Flow Sheet

Simplified flow diagram in figure 2, shows the major preparation equipment in the Leatherwood No. 2 plant and gives a general picture of the coal flow. At this point, it might be of interest to note that the entire 14-in. by 0 feed is washed in the Leatherwood No. 2 plant and that, according to all available information, this represents the widest size spread in coal washing practice up to this time. Raw coal from the run-of-mine bin enters the plant, at a rate of 400 tph, through a 12 by 18-ft McNally-Pittsburg rotary breaker (3)* in which the top size of the feed is reduced to 14 in. A unique feature of the rotary breaker in this plant is the fact that it serves no scavenging function since it is constructed with a closed eye. The breaker serves only to reduce the size of both coal and rock to the maximum size, in this case 14 in., that the coal and refuse systems were designed to handle.

From the rotary breaker, the raw feed is conveyed over a belt conveyor scale (7) and a magnetic pulley located at the discharge end of the raw coal belt (5) to a 7-ft raw coal shaker screen (8) where a two-in., round-hole separation is made. The 14 by 2-in. overproduct from this screen is discharged to a nine-ft McNally-Tromp lump bath (9) which is maintained at a specific gravity of 1.50 to 1.55. The gravity separation in the lump bath is not critical because of the lack of middle-gravity material in this size range. The 2-in. by 0 under-product from the raw coal shaker is split over two raw coal vibrating screens (34) from which the 2 by 14-in. overproduct is discharged into a nine-ft McNally-Tromp small coal bath (37) and the ¼-in. by 0 underproduct is sluiced to the fine coal cleaning circuit. The specific gravity in the small coal bath is maintained at 1.39 to 1.44. Proper specific gravity of the bath in each of the McNally-Tromp washers is maintained by the use of automatic density regulators (120).

Under normal operating conditions, the 2 by ¼-in. float material from the small coal bath, after passing over a floats rinsing screen (38) equipped with high-pressure fresh water sprays, passes through a McNally-Vissac screen-type heat dryer (205) from which it is conveyed to the loading and blending points. If necessary, for any reason, the nut coal dryer can be bypassed.

Before presenting a detailed discussion of the fine coal circuit in the Leatherwood No. 2 plant, it will be of interest to note the method by which the 2 by ¼-in. middlings product is recovered since the method is quite unusual and, possibly, unique. The 2 by ¼-in. sink material from the small coal bath, after passing over a sinks rinsing screen (41), can either be sent directly to the refuse bin (49) or conveyed back to the discharge end of the raw coal shaker screen (8) where it joins the 14 by 2-in. feed to the lump coal bath. Thus the discharge from the lump bath consists of the 14 by 2-in. coal which floats at 1.50 to 1.55 and the 2 by ¼-in. middlings product which is obviously a 1.39-1.44 sink and 1.50-1.55 float material. It is, of course, a simple matter to recover the middlings product by a screen separation at two in. on the floats rinsing screen (10). Since this screen would have been necessary for medium recovery in any event, the cost of the equipment for coarse middlings recovery was limited to the cost of the conveyors carrying the product from the small coal sinks rinsing screen to the lump bath and from the lump bath floats rinsing screen to the middlings bin (78).

Cleaning Fine Sizes Is A Real Problem

As heretofore mentioned, the real cleaning problem on the Leatherwood No. 2 coal is in the fine sizes. As indi-

* Figures in parenthesis following each item of equipment mentioned in this discussion are Unit Numbers by which the various components may be located in Figs. 2 and 3. Units are identified as to size, type, model and manufacturer in Table 1.

cated by the 1.50-1.55 gravity employed in the lump coal bath, most of the large impurities consist of heavy rock which presents a relatively simple cleaning job. In view of the importance of doing a difficult cleaning job well and economically, the equipment and methods employed in the fine coal circuit of this plant were selected after a great deal of deliberation and, although there may be several instances of unusual application, there is nothing in any way experimental involved in any part of this circuit.

While the Blue Diamond Coal Co. is most certainly not averse to experimentation, the policy of the company has been not to conduct experimental work in preparation plants where failure of equipment or methods to measure up to predicted standards of performance would be likely to result in customer dissatisfaction. Consequently, all of the equipment and processes selected for the Leatherwood No. 2 cleaning plant have proven records of satisfactory performance where difficult cleaning problems are involved.

Figure 3 is a detailed flow sheet of the Leatherwood No. 2 fine coal and refuse circuits. From the raw coal vibrating screens (34) the minus ¼-in. material, at the rate of 80 tph, is sluiced to a large, conventional type drag tank (51) which serves the following purposes:

(1) Because the tank is equipped with a variable discharge feature and has a storage capacity of about 22 tons of coal, it provides at least 15-min surge capacity in the fine coal circuit.

Product	% Weight	% Ash
Washed Coal	56.05	6.00
Middling Screen Oversize	17.15	27.19
Refuse	26.80	75.50
¼ in. x 48 M Feed	100.00	28.26

(2) Also because of the variable discharge feature, which allows for recirculation of excess feed, the tank serves as a mixer and blender to smooth out reject surges and size consist variations.

(3) The drag tank serves further to thoroughly wet the dry fines preparing them for feed to the concentrating tables.

(4) Desliming is the final purpose of the drag tank. Slimes go directly from the drag tank overflow to the fine refuse thickener and not over the tables and through the entire fine coal circuit. Table feed is repulped with clear, reclaimed water.

From the drag tank, the ¼-in. by 0 fines are discharged to a rotary distributor (54) which proportions the feed to eight Deister No. 7 Super-Duty Diagonal Deck Concentrating tables (56). Use of the rotary distributor allows any one of the eight tables to be taken out of service for emergency repairs or routine maintenance. Maximum rate of feed to the Deister tables is 10 tph per table.

Before continuing with the flow of coal through the fine coal circuit, reference to washability studies on the Leatherwood No. 2 fine coal will serve to point up some of the difficulties involved in cleaning that coal effectively. The accompanying table shows the washability data upon which the design of the fine coal cleaning circuit was based. On the basis of a gravity separation at 1.39-1.44, some 35 to 40 percent of the table feed falls in the specific gravity range from 0.10 units below to 0.10 units above the gravity at which separation is effected. According to one of the more popular methods of evaluating difficulty of cleaning, such a feed represents a "formidable" cleaning problem.

There are, of course, other standards by which cleaning difficulty can be measured but the ± 0.10 method, despite any limitations it may have, serves as well as any other indicator when considering a coal containing as high a concentration of middle-gravity material as that found in the Leatherwood No. 2 fine coal. Based on the foregoing washability data the above is a guaranteed, and in all probability a very conservative, prediction of the performance to be expected from the concentrating tables when cleaning the Leatherwood No. 2 fines at a feed rate of 10 tph per table.

TABLE 1.—*DESCRIPTION OF EQUIPMENT

No.	Unit	Mfgr	Description
3	Rotary Breaker	McNally-Pittsburg	12 x 18 ft, 14½-in. perf., closed eye
5	Broken Coal Belt Conveyor	Hewitt-Robins	36-in. rubber belt conveyor
7	Belt Conveyor Scale	Fairbanks-Morse	
8	Raw Coal Shaker Screen	McNally-Pittsburg	Parrish type, 2-in. r.h. screen plate
9	Lump Coal Bath	McNally-Pittsburg	9-in. McNally-Tromp Dense Media (Magnetite)
10	Lump Coal Floats Rinsing Screen	Hewitt-Robins	72 x 168-in. "Eliptex"—Top Deck: 1¾ in. sq Bottom Deck: ¼ x 1½ in. Type 1 Slot
34	Raw Coal Vibrating Screens (2)	Allis-Chalmers	5 x 14 ft "Ripl-flo"—Top Deck: ¾ in. sq Bottom Deck: 3/16 x 3⅛-in. Slot
37	Small Coal Bath	McNally-Pittsburg	9 ft McNally-Tromp Dense Media (Magnetite)
38	Small Coal Floats Rinsing Screen	Allis-Chalmers	6 x 16 ft "Lo-Head"—Top Deck: 1¼-in. sq Bottom Deck: ¾-in. sq
41	Small Coal Sinks Rinsing Screen	McNally-Pittsburg	6 x 20 ft Single Deck—1st 10-ft section: ¾ mm—2nd 10-ft section: 3 mm
49	Refuse Bin	McNally-Pittsburg	Conical steel bin—Capacity: 150 tons
51	Recovery Drag Tank	McNally-Pittsburg	6 x 42 x 9 ft steel tank—Capacity: 15 tons
54	Table Feed Distributor	Deister Conc. Co.	Rotary type
56	Concentrating Tables (8)	Deister Conc. Co.	Model HCRD No. 7 Super-Duty Diagonal Deck
58	Clean Coal Sump	McNally-Pittsburg	Conical steel bin
60	Clean Coal Vibrating Screen	Allis-Chalmers	6 x 16 ft "Lo-Head"—Top Deck: 3/16 in. sq Bottom Deck: ½ mm
74	Middlings Screen	Allis-Chalmers	3 x 12 ft "Lo-Head"—Single Deck: 14-Mesh
78	Middlings Bin	McNally-Pittsburg	Conical steel bin—Capacity: 75 tons
85	Clean Coal Vacuum Filter	Dorr-Oliver	Disc type—32-mesh Saran cloth
120	Bath Regulators (2)	McNally-Pittsburg	Balanced-beam type automatic density regulators
128	Medium Classifying Cone	McNally-Pittsburg	Conical steel classifier
177	Fine Refuse Vibrating Screen	Allis-Chalmers	3 x 16 ft "Lo-Head"—Single Deck: ½ mm
180	Centrifugal Fine Coal Dryer	McNally-Pittsburg	Basket-type "Dryclone"—1/16 in. perf
181	Dryer Effluent Screen	Allis-Chalmers	3 x 10 ft "Lo-Head"—Single Deck: ½ mm
184	Clean Coal Thickener	Denver Equip. Co.	20-ft steel—Beam-type, Spiral Rake
188	Fine Refuse Filter	Dorr-Oliver	Disc Type
197	Fine Refuse Thickener	Denver Equip. Co.	75-ft concrete—Truss-type, Spiral Rake
205	Nut Coal Thermal Dryer	McNally-Pittsburg	Size 7520 McNally-Vissac—Down-draft type
222	Fine Coal Thermal Dryer	Link-Belt	No. 1224 Multi-Louvre
231	Dried Coal Vibrating Screen	Hewitt-Robins	6 x 16-ft "Gyrex"—Single Deck: 3/32 x 1½-in. Type S Slot

* This table covers only equipment to which reference is made in the text.

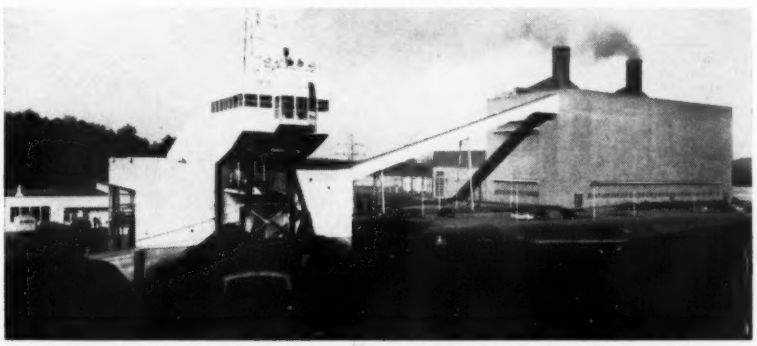
LEATHERWOOD NO. 2 MINE—FLOAT AND SINK TABLES

Specific Sink	Float	% Wt.	Dry Basis % Ash	Cum. Recovery (Float) % Wt.	Cum. Recovery (Float) % Ash	Cum. Reject (Sink) % Wt.	Cum. Reject (Sink) % Ash
Composite ¼-in. Rd. x 48-Mesh = 17.3% of Raw Run of Mine							
	1.30	26.3	2.71	26.3	2.71	100.0	28.26
1.30	1.35	20.3	5.82	46.6	4.06	73.7	37.38
1.35	1.40	7.2	11.57	53.8	5.07	53.4	49.38
1.40	1.45	5.3	16.50	59.1	6.09	46.2	55.28
1.45	1.50	4.3	21.41	63.4	7.13	40.9	60.30
1.50	1.60	5.8	29.21	69.2	8.98	36.6	64.87
1.60	1.90	8.0	45.38	77.2	12.76	30.8	71.59
1.90		22.8	80.78	100.0	28.26	22.8	80.78

Dewatering and Drying

Referring again to figure 3, the clean ¼-in. by 0 is discharged from the concentrating tables to a clean coal sump (58). The ¼-in. by 0 middlings product from the tables passes over a 14-mesh middlings screen (74) from which the ¼-in. by 14-mesh material is conveyed to the middlings bin (78). This material may also be conveyed directly to the refuse bin (49). Because of the nature of the impurities in the coal and the classifying action of the concentrating tables, the minus 14-mesh underproduct from the middlings screen is low in ash and is, therefore, discharged to the clean coal sump. From the clean coal sump the washed ¼-in. by 0 is pumped as a slurry to a double-deck clean coal louvre dryer surge bin. Underproducts from both the clean coal and the dryer effluent screens are sent to a 20-ft clean coal thickener (184), from which the thickened underflow is pumped to a clean coal vacuum filter (85). The clean coal discharge from the vacuum filter is also conveyed to the multi-louvre dryer surge bin. The thermally-dried ¼-in. by 0 carbon, at a maximum surface moisture of two percent, is conveyed from the multi-louvre dryer to the final crushed coal screening section of the plant.

At this point the washed and dried carbon may be combined with the crushed ¼-in. by 0 degradation from the stoker plant and either loaded separately or blended, in varying proportions, with either 2 by ¼ or 1¼ by ¼-in. nut coal to produce commercial stoker and modified nut and slack preparations. It is also possible to load either a 2 by ⅛ or a 1¼ by ⅛-in. commercial stoker preparation by passing the thermally-dried ¼-in. by 0 carbon over a dried coal vibrating screen (231), mixing the ¼ by ⅛-in. coal with the larger nut sizes on the loading conveyor and loading the ⅛-in. by 0 carbon separately.



Consumer requirements were a primary consideration in the selection of the design for the Leatherwood No. 2 plant

screen (60). The purpose of this screen is to separate the ¼-in. by 0 clean coal into sizes which can be handled with a minimum of degradation and most economically dewatered so that when they are recombined the total surface moisture will meet the evaporated specifications of the thermal dryer.

The 3/16-in. by ½-mm middle-deck product from the clean coal screen passes through a McNally Dryclone centrifugal dryer (180) after which it is recombined with the ¼ by 3/16-in. overproduct from the screen on a conveyor discharging to a surge bin ahead of a No. 1224 Link Belt multi-louvre thermal dryer (222). Effluent from the centrifugal and Vissac dryers passes over a ½-mm dryer effluent screen (181) with the overproduct joining the dewatered ¼-in. by ½-mm coal on the conveyor to the multi-

Refuse Handling

Turning from the clean coal circuit to the fine refuse circuit, it is of interest to note that an entirely separate thickening and filtering system has been provided for water clarification and fine refuse recovery. Refuse from the Deister concentrating tables passes over a ½-mm refuse screen (177) with the overproduct going directly to the refuse bin (49). The minus ½-mm refuse joins the overflow from the clean coal thickener and the mixture is pumped to a 75-ft fine refuse thickener (197). Also feeding to the fine refuse thickener are the overflows from the drag tank (51) and the medium classifying cone (128) and the filtrates from the clean coal and fine refuse vacuum filters. The thickened underflow from the refuse thickener is pumped to the refuse vacuum filter (188) from which the filtered material is conveyed to the refuse bin.

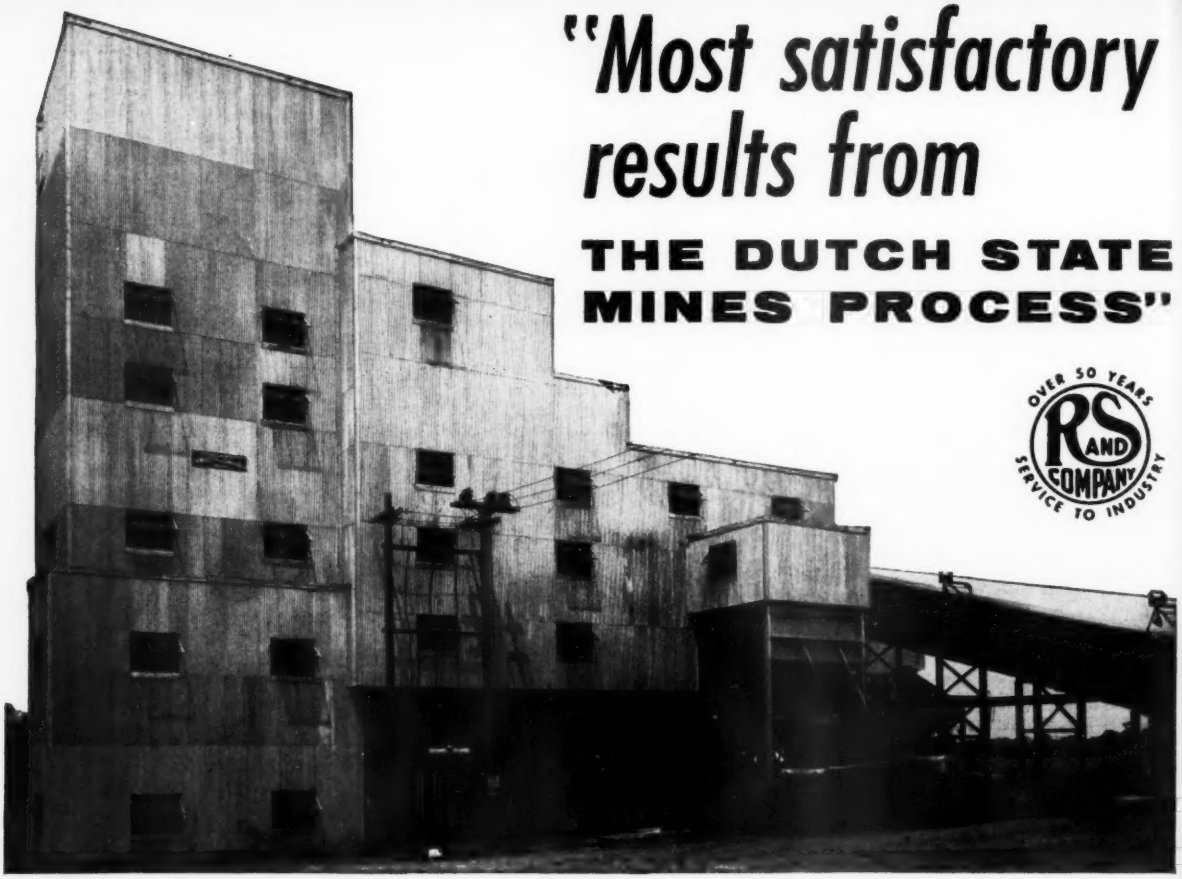
In answer to the one question which will inevitably arise at this point, the Leatherwood No. 2 cleaning plant does not operate with a fully-closed water circuit. Purchasers of premium-grade coals are extremely critical of the grayish cast imparted to coal by the adherence of even a microscopically thin film of slimes, consequently extensive use of high-pressure fresh water sprays is practically mandatory. The large quantity of water introduced for the purpose of fresh water spraying makes it impossible to close the circuit within the plant itself. As a matter of practical necessity, however, the Leatherwood No. 2 water circuit has been closed by the use of large-capacity underground storage and settling reservoirs. Closing the circuit in this manner is of considerable importance not only because of the ever-present stream pollution problem but also because of the fact that the water supply in the locality of the Leatherwood operations is not always entirely adequate.

Summary and Conclusions

On the basis of some six months of operation, it can be reported that mechanical difficulties normally associated with the shakedown period of any plant of this size and complexity were fewer by far than had been anticipated. It is, of course, much too early to report upon such things as service life of equipment, overall cost of operation, and capacity of the various circuits and individual components under all conditions of operation. Insofar as plant capacity is concerned, there have been numerous occasions on which the plant has been operated at tonnages considerably above the design rating with only minor difficulties attributable to over-capacity operation.

From the standpoint of product quality it may be stated that, under the operating conditions which have obtained to date, the ash and moisture contents of all sizes and grades thus far produced have fallen well within the guaranteed design specifications. On the whole it would appear, on the basis of experience up to this time, that plant performance will conform to design expectations in virtually every respect and that the Leatherwood No. 2 plant will prove to be an extremely valuable addition to the preparation facilities of the Blue Diamond Coal Co.

"Most satisfactory results from THE DUTCH STATE MINES PROCESS"



OVER 50 YEARS — R AND S COMPANY — SERVICE TO INDUSTRY

Dutch State Mines heavy medium process showing the static pool vessel and flights removing pure coal.

Pure coal after the final rinse.

says Frank Nugent, Executive Vice President, Freeman Coal Mining Corporation, speaking of his experience with the Dutch State Mines heavy medium separation process installed by Roberts & Schaefer in Freeman Mine No. 4 Williamson County, Illinois.

Freeman had approached R & S engineers with the problem of obtaining high quality coal from their new mine operating in the quality circle in Southern Illinois. This was the perfect application for the recently acquired Dutch State Mines process. With more than 50 years of coal preparation plant experience, including the designing and building of the most modern washing equipment for normal coal preparation, Roberts & Schaefer had realized that the trends required more precise cleaning. They had, therefore, secured the franchise to market the Dutch State Mines process in the United States. R & S were ready. Freeman needed the best coal washing equipment in the world—and they got it!

The plant has now been in operation for over six months and has thoroughly proved its efficiency; in fact, results are far better than were originally thought possible. As a result, Freeman is producing quality coal for quality customers.

Do you have a washing problem that is unusually severe? Possibly the Dutch State Mines process is what you need to solve it. Phone, wire or write for consultation.

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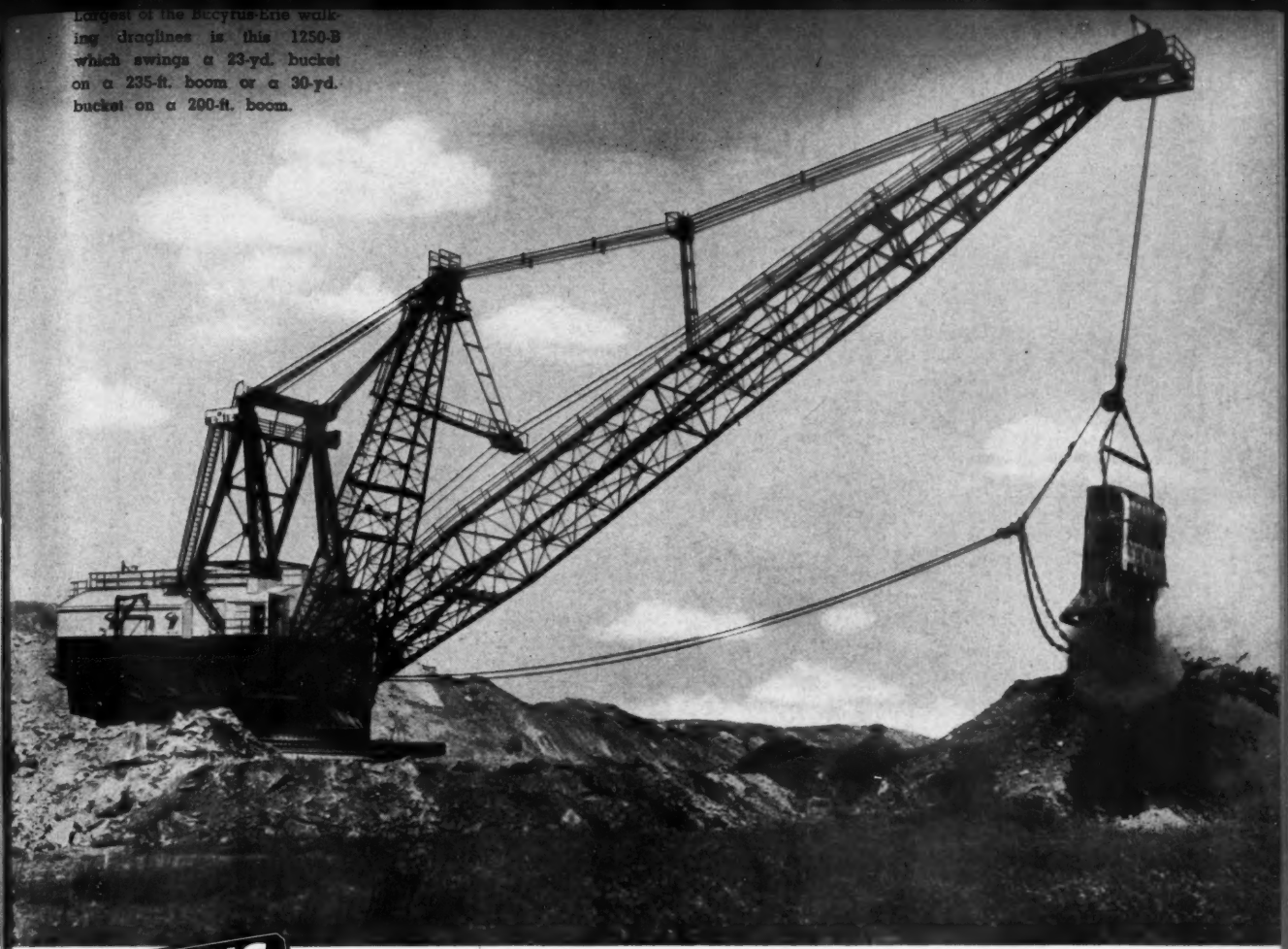

Largest of the Bucyrus-Erie walking draglines is this 1250-B which swings a 23-yd. bucket on a 235-ft. boom or a 30-yd. bucket on a 200-ft. boom.

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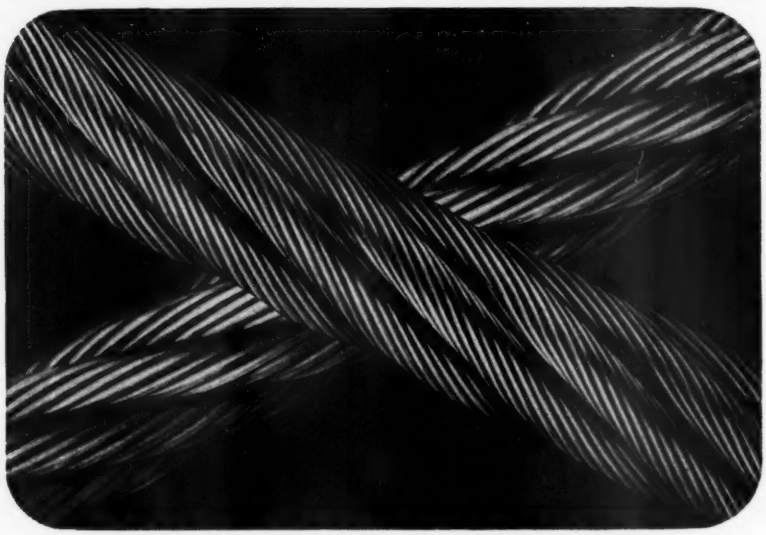

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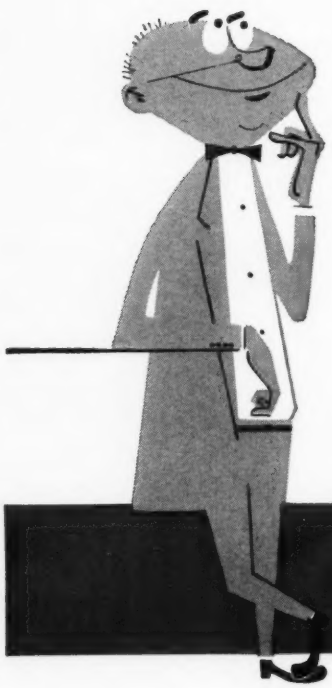

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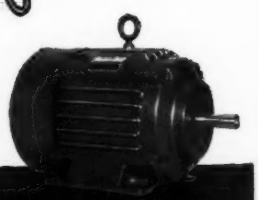

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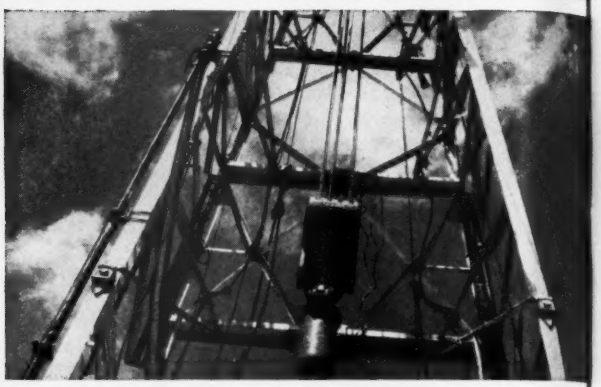

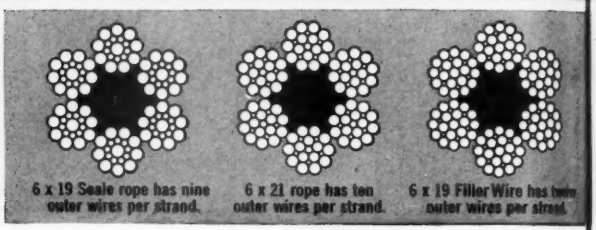

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Development of industry in desert areas is entirely dependent on water available

Ground-Water Problems in Desert Areas

Cooperation in Collection of Data to Resolve the Problems of Water Use Is Vital to Continued Development of the West

By HUGH A. SHAMBERGER
Nevada State Engineer

PERHAPS one of man's most important discoveries was made when he found he could obtain water under dry land by digging a hole in the ground. Without the aid of well drilling, man's activities would have been confined within a narrow radius of rivers, creeks and springs; he would not have ventured far into the desert areas which cover a large part of the world. Yet, despite all of the liberties and opportunities that ground-water has given man, and through all of the centuries that he has probed into the earth in search of water, surprisingly little was known about the source of this blessing until modern times. Now, largely due to the work of the Ground Water Branch, Water Resources Division, of the U. S. Geological Survey, the science of ground-water hydrology has been developed to a point where a comprehensive ground-water investigation of an area will serve as the basis for the safe development and full utilization of its ground-water resource.

The late Dr. O. E. Meinzer, for many years Chief of the Ground Water Branch of the U. S. Geological Survey, stated that "the Scientific study of the ground-waters of the earth is properly regarded as a branch of economic geology, for it relates to a mineral product of economic value occurring in the rock formations."

Importance of ground-water to our national economy and the development of our country cannot be over-estimated. According to figures developed by the U. S. Geological Survey, the approximate use of ground-water in the United States in 1951 was 25 billion gallons per day. This is equivalent to about 27,500,000 acre-ft of water yearly or about twice the flow of the Colorado River. Over 50 percent of this was used for irrigation with industrial uses consuming about 20 percent of the total. Furthermore, our surface-water supplies in the arid states are practically all appropriated, and future development must depend to a great extent on the ground-water resources. The arid west is dotted with many valleys under which lie ground-water reservoirs—some large and some small—but all very important. How much they will contribute to our economy depends on how they are managed.

The ground-water problems of one locality are rarely unique, for other localities have encountered similar problems and in many instances satisfactory solutions have been found. However the water problems of the arid west are the most serious and complex in the Nation. Because of the general deficiency and great value of water, the arid region has had more detailed hydrologic studies, the most ambitious water development programs, and greatest development of systems of establishing water rights.

Water Problems Defined

Dr. H. E. Thomas of the Geological Survey, in his recent book, "The Conservation of Ground-Water" has described three major types of ground-

water problems resulting from development and use. These are: (1) reservoir problems in which pumping exceeds the rate of replenishment as in certain areas of the west and southwest; (2) pipeline problems, such as in municipal and industrial well fields where local pumping exceeds the ability of the aquifers or natural pipe lines to transmit water; and (3) watercourse problems, involving aquifers that communicate with nearby streams.

These three problems are all present in the arid states as well as nationwide in varying degrees.

Other problems arise as we seek to resolve the problem of water shortage by the conservation of water. For instance many problems become apparent in finding ways to conserve the vast quantities of ground-water that are used non-beneficially by water-loving plants called "phreatophytes" (plants whose roots tap the water table or the capillary fringe above it). Recently the Pacific Southwest Federal Inter-Agency Technical Committee compiled a list of such plants that present major water-waste problems in the Southwestern United States. Included in this list are alder, rabbitbrush, arrowweed, cottonwood, mesquite, willow, big greasewood, saltcedar and saltgrass. T. W. Robinson of the Ground Water Branch, U. S. Geological Survey, made a recent study of the use of water by phreatophytes in the 17 western states. He found on the basis of meager, incomplete data that such non-beneficial plants grew on some 15,000,000 acres and used from 20,000,000 to 25,000,000 acre-ft of water annually. In Nevada alone the study indicated that such plants were growing on 2,800,000 acres and were consuming about 1,500,000 acre-ft annually.

In arid west only mountain areas ordinarily receive precipitation in excess of immediate moisture requirements

Water Salvage Methods

It is known that by proper development by means of wells, ground-water can be lowered below the root zone of the phreatophytes, thus causing them to die out. The water used by phreatophytes probably represents the largest source of reclaimable water in the arid western states. Salvage of such water may, according to Robinson, be divided into two basic operations:

(1) Reduction of consumptive waste, as by pumping or drainage;

(2) Increased efficiency of use, as by substituting plants of high economic value for plants of low economic value.

How much of this consumptive waste can be salvaged is not known, but fortunately many agencies, including the Geological Survey, are carrying on intensive studies relative to the problem.

Methods of Recharge

Problems also arise in the practice of conserving water by artificial recharge which is the addition of water to underground reservoirs by man. In some instances this represents a means of increasing the practicable rate of withdrawal. The two principal methods of recharge are those generally known as "water-spreading" and the injection of water through "recharge wells."

Water-spreading at present is used on the largest scale in California. There, water from streams is diverted onto permeable ground as a sheet flow or into basins or furrows. Such artificial recharge depends of course on having surface-water available. Consequently in many of the arid states the opportunities to carry on programs of "water-spreading" are scarce. However, much can be done to improve natural conditions at the intake area on the alluvial fans so that more of the natural runoff percolates into the ground instead of running to waste in the valleys below.

"Return wells are becoming increasingly important in the arid states as a means of water conservation. In the Las Vegas Valley considerable heating and cooling is being done with ground-water by utilizing heat exchange principles. In order to save water, the State requires that water used exclusively for heating or cooling be kept in a closed circuit and that it be returned to the ground-water aquifer from which it was obtained. In this practice water is diverted from one well and then after circulation is returned by means of another well located a short distance, possibly not more than 100 ft, downgrade from the "intake" well. Most difficult problem here is to obtain the proper construction of both wells so as to prevent pollution and waste.

Salt Water Encroachment

A most important problem is that of salt water encroachment. This is critical along the coastal areas in Southern California and to some extent in the inland areas. Throughout much of the arid west there is the possibility that excessive pumping may cause water of poor quality to rise from a lower-lying aquifer and enter wells. Streams of poor quality may also contaminate nearby wells with which they are hydrologically connected. Still another major problem, and a major one, in Nevada, and probably throughout the Nation, is the prevention of ground-water pollution caused by improper well construction, poor well location, and the practice of using wells to dispose of waste material.

The Hydrologic Cycle

Now, departing briefly from water problems, let us discuss a few hydrologic principles. Essentially, all usable water supplies are in motion—a part of the vast circulatory system known as the "hydrologic cycle." In the first step of the cycle, water goes into the atmosphere by evaporation, from open bodies of water such as streams, oceans and lakes and from any other water surfaces exposed to the atmosphere. The second step is precipitation. Air masses laden with moisture may move for long distances before cooling sufficiently to condense the moisture obtained during the first step of the cycle thus causing it to fall as rain or snow, or to form as dew. In the third step the precipitated water moves downgrade by various routes. A major part runs off as surface-water to form streams, rivers, etc. However, some percolates into the soil. Part of this is retained and held there until withdrawn by plant life or by evaporation. The balance moves downward to lower areas of discharge.

All water eventually returns to the atmosphere and is redeposited by precipitation at other places, often long distances away. It can be readily seen that water moves restlessly and eternally between open bodies of water, the skies, and the land, and that it is

a transient resource. Water may be wasted through inefficient use at some point in its cycle, but never lost permanently. Water may escape from a region where it is badly needed to a region that already has too much. The total quantity, however, is not reduced or increased; all of it is still available for use somewhere at some future time.

Natural Recharge Varies

In the arid west, ground-water recharge is greatly different from that in the east. It does not occur directly beneath the area that receives precipitation, as is common in much of the east. Recharge to the ground-water reservoirs of the western valleys is dependent on the movement of ground-water from the adjacent mountainous areas to the sediments of the valley fills. Only the mountain areas ordinarily receive precipitation in excess of immediate moisture requirements. Thus they are the only areas from which recharge of the ground-water reservoirs can originate. Naturally, the amount of water reaching the ground-water reservoir is governed in large part by the size of the watershed and the amount of precipitation that falls upon it.

In many of the valleys in Nevada the thickness of the alluvial fill is well over 1000 ft and this is generally true throughout the southwest. The storage capacity of such ground-water reservoirs is tremendous. However, the water in storage is not always available to wells in sufficient quantity and at pumping lifts that are economically feasible. The wide variations in the water-bearing properties of the sediments of the valley fill, both laterally and vertically, must be recognized when planning any program for the development of ground-water.

Balance of Reservoirs

In its natural state, ground-water in an area or basin ordinarily is in balance. That is, the outflow at lower elevations through springs and seeps, and use by plants and trees is equal to the inflow from rain and snowfall on the recharge area. However, when artificial withdrawals are made such as diverting water from the ground-water reservoir by wells, the natural balance is upset. Water levels decline and if the withdrawals are excessive the water level ultimately may drop to a level from which water can no longer be pumped economically, or the ground-water reservoir may be virtually depleted. If, on the other hand, the volume of water withdrawn from an area is carefully planned in relation to the supply and the recharge, a new balance can be established between intake and outflow that will permit such withdrawals to be made indefinitely without endangering the water supply.

This leads back to the "reservoir problems" discussed by Dr. Thomas in his book "Conservation of Ground-Water." Discussion of such problems usually revolves about the proposition of "sustained yield vs. mining of ground-water." By sustained yield is meant the holding of withdrawals from the ground-water basin, including all losses, to the average recharge to the basin. This provides a yield of a limited amount of water as long as such a program is carried on. Each ground-water reservoir has a sustained yield to which it can be developed for human use.

Opposed to sustained yield is "mining of ground-water." In the mining of ground-water, there is a progressive loss as withdrawals continue to exceed replenishment to the basin. Ultimately the ground-water levels will drop to a point where pumping is no longer economical. Under such conditions the ground-water reservoir is being emptied of water that may have taken centuries to accumulate. Nearly all of the present excessively pumped reservoirs are in desert regions where precipitation is generally inadequate for the needs of man. A notable example, where ground-water is being mined, is the southern high plains of Texas where the pumpage is on the order of a million acre-feet per year; yet the average annual replenishment is approximately 50,000 acre-feet.

Solution Not Easy

In Nevada there are certain areas, one in particular, where the average annual replenishment may be about 5000 acre-feet but where there is a ground-water reservoir that perhaps contains 2,000,000 acre-feet of water within economical pumping lifts. The question is—should the water be extracted for maximum benefit of the present generation as minerals and other non-renewable resources are mined, or should the pumping be limited to the small quantity that can be supplied perennially

The problems presented by the over-development of ground-water resources admit of no easy solution. In many instances in California, Arizona, New Mexico, Texas, Utah and Nevada extensive development, commercial, agricultural and industrial, have been founded upon a water supply obtained by "mining" the available ground-water resources. To summarily reduce the demand on the ground-water to the safe yield, unless a source of supplemental water is available, might well cause severe economic and sociological dislocations.

Obviously, the maximum usefulness of the ground-water reservoirs over a long period calls for development of their sustained yield rather than the mining of their water. Each basin must be treated individually and perhaps the solution will bear greatly on (1) whether or not the ground-water basin can be replenished by surplus stream water by using water-spreading methods, and (2) whether or not water can be imported from other areas to supplement the ground-water.

Case of Las Vegas Valley

The situation that faced the State Engineer in the administration of the ground-water law in the Las Vegas Valley presented an interesting case. A cooperative ground-water study with the U. S. Geological Survey, started in 1945 and completed in 1948, indicated that the average annual replenishment to the ground-water basin was between 30,000 and 35,000 acre-feet. The studies further indicated that the withdrawals of water from the basin in 1946 were over 35,000 acre-feet. We were then faced with the problem of whether to curtail further drilling of wells so that a balance between recharge and discharge could be maintained or whether to allow the "mining" of the ground-water supply.

Prime considerations in working out a policy here were the availability of an additional supply of water from Lake Mead and the desire of the people to form a water district and initiate steps to import water from Lake Mead. Further drilling was allowed and development in the valley went ahead rapidly. The Las Vegas Valley Water District was formed in 1947 and in 1953 the electorate of the district approved an $8,700,000 bond issue for the purchase and improvement of the existing water system in Las Vegas and for the construction of transmission facilities to bring in Lake Mead water. Initial delivery of Lake Mead water into the Las Vegas area will be made soon.

The lesson here is obvious. By allowing the "mining" of ground-water the population and taxable wealth of the valley increased to a point that made it possible for the people to import Lake Mead water into the valley. Had the policy been followed of not allowing the "mining" of ground-water, it is unlikely that the financial resources of the valley could have been developed to the extent necessary to support the costs of importing Lake Mead water and consequently the area would have remained more or less static. The availability of an additional supply of water was the key to this solution.

Doctrine of Appropriation

Another problem mentioned by Dr. Thomas was what he referred to as "watercourse" problems. Such problems result from pumping wells along rivers, where there is an interconnection between the ground-water and the surface-water, and such pumping depletes the stream flow. Here again each area requires a separate study. In an area where pumping from wells depletes stream flow, thus adversely and to an appreciable degree affecting

a prior appropriator, we have a "watercourse" problem which could become serious. In Nevada, where the doctrine of appropriation applies to ground-water as well as to surface-water, the matter of control rests in the hands of the State Engineer.

Inasmuch as the methods handling some of these problems depends upon the laws of the individual state relating to ground-water, brief comment on such laws is appropriate. Nevada's comprehensive ground-water law is similar to the surface-water law. The doctrine of appropriation applies to all ground-water and accords rights of use of water based upon priority in time of acquiring the right. Appropriative rights are acquired regardless of whether the water is diverted from beneath the land where it is to be used, or diverted from a well located off the land. Land ownership in itself gives the owner no right to the use of the water lying beneath such lands. Such right to use water must be acquired under provisions of law.

This differs from states where the law of percolating waters follows the English rule of absolute ownership by the owner of the overlying land. This rule is still in effect in several western states, but generally with some restrictions that render the landowner's right less than absolute. In other western states the unsuitability of the English rule resulted in its replacement in various jurisdictions by the American rule of reasonable use. From this rule developed the California doctrine of correlative rights. This accords to the owners of lands overlying a common ground-water supply rights of use that must be reasonable with respect to each other, each proprietor being entitled to a proportionate part of the total available supply in the event of shortage.

In the arid southwestern states the doctrine of appropriation generally governs and many policy questions of major importance are constantly before the state engineers.

Initial delivery of Lake Mead water into the Las Vegas area will be made soon

Water Means Life

Only in recent years have our people become aware of the vital significance of what the availability for use of adequate and clean water means to the total complex of our society. We have entered the stage of competition not only for the use of water but for the right to use it. We are now beginning to recognize that water means life, both economic and physical. How much water will be needed by industry, by agriculture and by our cities to meet the rapid growth in our population, now estimated to exceed 200,000,000 people by 1975? How will our water supplies be divided up between industrial, domestic and agricultural uses? And what can be done to meet the increasing demands for water?

These questions all indicate the absolute necessity of developing a more complete program of data collection so necessary for the formulation of adequate policies and plans for developing to the fullest extent our usable ground-water resources. We need to know more about water and how it behaves after it falls upon the land as rain or snow. We need to recognize that the management of water begins where the rain and snow fall upon the earth and that soil and water are so closely associated that the problems pertaining to both are inseparable, and we must realize that these programs must be developed on an interstate basis as well as intrastate.

We need to know more about water and how it behaves after it falls upon the land as rain or snow

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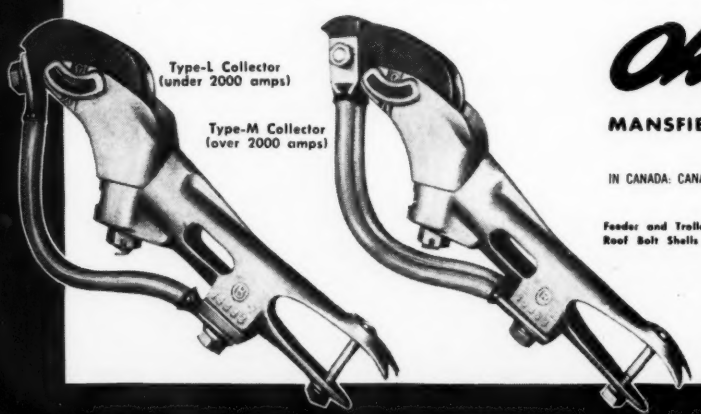

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The coal mining industry has not profited from the use of silicone insulation as much as have other industries because of excessive brush-wear in non-ventilated d-c motors, commonly found in coal mining equipment

Advantages and Limitations of Silicone (Class H) Insulation

Higher Operating Temperatures Possible in Mining Equipment Motors Through the Use of This Unique Family of Materials

THIS article is designed to stimulate thinking about silicone insulation as it applies to the mining industry. It should be pointed out, however, that much work is being conducted in the application of silicone insulations and current developments may in time alter certain statements that follow.

It is the purpose of this article to present an accurate picture of the present status of silicone installation and to point out the advantages and limitations with respect to electric motors for application to mining.

Silicones are a family of materials possessing unique properties. When used as electrical insulation, they have helped to solve a number of problems in the design and operation of electrical equipment. They may aid in the solution of still other problems in the future.

As always, when new materials are developed, their use introduces new complications which have to be overcome.

Early silicone varnish did not do a satisfactory job of bonding glass covering to magnet wire or of sticking the flakes of mica together. Furthermore, the early silicone varnishes required a baking cycle of more than 80 hr at two oven temperatures. One of these was much higher than that normally found in manufacturing and repairing establishments. Due to this difficulty, the resulting coil was likely to have a rough and pitted surface with uncured spots in the center. Excessive brush wear and failure of other related components and apparatus resulted from the unexpectedly high operating temperatures of the motors.

During less than a decade manufacturers and fabricators have pursued an aggressive program of research and development in the application of silicones. They have learned to produce uniformly excellent silicone varnishes. At the same time, they have reduced the baking cycle to approximately 20 hrs. The brush wear problem has been attacked and partially solved, and improved design and materials have helped to eliminate many failures in associated components.

Advantages Realized in AC Motors

Effect of silicone insulation, or Class H insulation, as it is officially designated, in ac induction motors will be considered first. It is here the designer has been able to use its best points to advantage and to avoid the disadvantages of its worst limitations.

The stator winding of an ac induction motor is the focal point of the silicone insulation. It will contain coils made of round or rectangular wire, insulated with a glass covering bonded to the wire with silicone varnish. Insulation to ground and to opposite polarity will consist of sheet

materials of various combinations of mica and glass fabric bonded together with silicone varnish or woven glass tubing impregnated with silicone varnish and/or with silicone rubber. Stator leads will have silicone rubber insulation, covered with a glass braid impregnated with silicone varnish. The completed winding is impregnated with silicone varnish and cured by baking.

At the present time materials and manufacturing procedures have been so improved that a properly wound and processed silicone stator is of a quality comparable to that of the conventional Class B product. In fact, a few manufacturers enjoy a record of factory rejects that is no worse than for Class B windings.

Know-How of Silicones Is Scarce

The silicone insulated stator is more expensive because the materials are more expensive, the manufacturing procedures require more time and requires equipment designed specifically to handle silicone insulation.

Ability and equipment to apply silicone insulation properly is limited to a relatively few leading manufacturers and a smaller number of repair shops. This means the purchaser of silicone insulated windings must be particularly careful in his choice of suppliers.

Chief advantage of a silicone insulated stator winding is its ability to withstand considerably higher temperatures for the same life span as a Class B winding, or to provide a greater life span at Class B temperatures. This all adds up to greater output, greater life, or a combination of both.

The National Electrical Manufacturers Association has standardized on temperature rises for commercial motor applications. The standards are based on measurement of the rise by thermometer in an ambient temperature of 40° C. or 104° F. According to the NEMA standards, for a totally enclosed motor, Class A insulation is suitable for 55° C. rise (95° C. or 203° F. total temperature), Class B 75° C. rise (115° C. or 239° F. total), and Class H 115° C. rise (155° C. or 311° F. total). In Europe and in certain sections of U. S., Class B insulation is considered suitable for 130° C. total temperature and Class H is considered suitable for 180° C. total temperature.

Power Output Increased

If increased horsepower output of an existing design is the goal sought by use of silicone insulation, it must first be determined if the active materials within the motor, such as iron in the magnetic circuits, etc., are sufficient to supply the performance characteristics desired. If so, the continuous horsepower rating will be increased approximately 30 percent in changing from Class A to Class H or approximately 15 percent in changing from Class B to Class H. It must be understood that this is an average figure and will vary with individual designs. Limitations of other parts of the motor or special design features may nullify this increase.

Because of variations in designs an equivalent figure for increase in short time horsepower cannot be given.

If increased life is the goal sought through silicone insulation, its use will result in very definite improvement for any given operating temperature. The accompanying graph shows some average figures for thermal life of standard Class A, Class B, and Class H insulations.

Problems at High Temperature

While the use of silicone insulation at higher temperatures provides definite advantage in reduction of size of the equipment or in the life of the motor, the higher temperatures require further consideration of the remaining parts of the motor, as follows:

(1) The rotor; in some motor designs the thermal capacity of the rotor is the limiting factor. This is true especially in short time ratings and those subjected to high peak overloads or long and heavy accelerating loads. Increasing the thermal rating of the insulation will not help the overall motor performance unless the rotor will also stand the increased load.

(2) Bearings and lubrication; increased heat in the stator winding will cause a similar increase in bearing temperatures, requiring high heat stabilized bearings with special internal fit. Frequently changes are necessary to the fit of the bearing on the shaft and in the housing. If advantage is taken of full silicone insulation temperatures, the bearings will be above the temperature limits of conventional petroleum greases and it will be necessary to lubricate with silicone grease. Bearings with rubbing seals of composition material may not be usable at these high temperatures.

(3) Oil Seals of the inexpensive lip type have yet to be developed to operate properly at the shaft and bearing temperatures prevailing when the windings are at full Class H operating temperatures.

(4) When designing a motor for operation at full Class H temperatures, it is necessary to give careful consideration to the heat expansion of the mechanical parts to avoid interferences, rubbing parts, and preloaded bearings.

(5) The operating temperature of Class H insulation (155° C. or 311° F.) approaches the softening point of conventional solders used on the connections of many motors. High temperature lead solders, pure tin solders, or brazing must be used. Even if high temperature lead solder or pure tin is used to resolder a connection, any solder, unless it is the same composition remaining on the wire from the old joint, will contaminate the resoldered joint, possibly lowering its softening point.

(6) Multiple conductor cables for Bureau of Mines motors which will operate at Class H temperatures are available only in a limited range of designs. Conventional rubber covered cables are not recommended for continuous operation at total temperatures exceeding 80° C. or 176° F. AVC and asbestos-plastic cables are suitable for higher temperatures. The lack of suitable inexpensive Class H cable is a serious handicap.

The use of silicone insulation, because it permits a higher operating temperature, means that smaller motors can be used to do a job. This is important because of the confined space in some modern mining equipment

(7) When motors are to operate at Class H temperatures consideration should be given to danger of burns from accidental contact with hot motor frames.

(8) Consideration should be given to the proximity of gear reducers, and similar parts filled with conventional lubricants, and the effect on them of heat transferred from the silicone insulated motor.

Many advantages may be gained from the use of silicone (Class H) insulation in ac induction motors in longer life and economy in size and weight, providing the application of the insulation is done by a reputable manufacturer or repair shop with the know-how and equipment to do the job properly. Many motors now giving unsatisfactory service due to the short thermal life of Class A or Class B insulation may be helped if rewound with Class H.

Problems With DC Motors

In contrast to the excellent results obtained through use of silicone insulation on ac induction motors, the record with dc motors has been a series of troubles and frustration. This is particularly true for non-ventilated motors. As the majority of motors on heavy duty applications on coal mines are non-ventilated dc type, the mining industry has not gained as much from the development of silicone insulation as have many other industries.

If it were as practical to use silicone insulation on dc motors the advantages in size and weight and in longer winding life would be identical with those noted previously for ac induction motors.

If dc silicone insulated motors were to be operated at Class H temperatures they would be affected by the same limitations as ac motors, except, of course, the rotor problem. In addition, dc motors have their own specific list of supplementary problems as follows:

(1) The operating temperature of Class H approaches the annealing point the copper normally used in commutators, and the baking temperatures of 205-232° C. or 400-450° F. which must be held for a number of hours is definitely within the annealing range. Types of copper suitable for higher temperature must be considered to avoid commutator failure.

(2) Unless carefully designed for high temperature operation, the commutator may be distorted or develop high bars due to stresses set up by excessive expansion and contraction of the commutator parts.

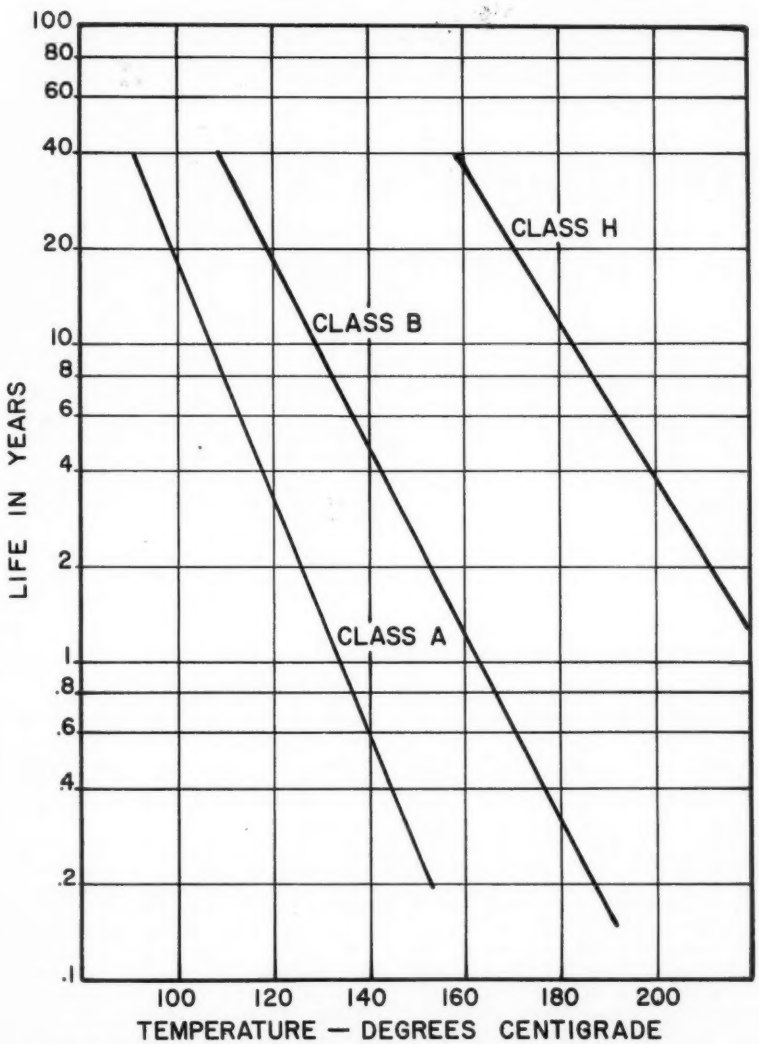
(3) Mica for commutator segments and V-ring insulators should be selected with care because additional development work is desirable on this type of insulation material.

(4) Consideration must be given to choice of solders for securing the armature coil leads to the commutator risers. The operating temperature of Class H approaches the softening point of conventional solder and the curing temperature exceeds it.

(5) Consideration must be given to the brushholder insulation to assure that it will operate satisfactorily at Class H temperatures.

(6) Consideration must be given to the brushholder springs to assure they will not anneal at Class H temperatures.

(7) Consideration must be given to excessive brush wear in non-ventilated motors. Ventilated motors are not affected by this problem.



Thermal life of three standard insulations at different operating temperatures

Causes of Brush Wear

The problem of excessive brush wear is of such magnitude that it deserves further comment. It was first noted by the U. S. Navy in motors and generators, using an enclosed circulating air system, installed on submarines.

Brush life on non-ventilated silicone insulated motors operated at full Class H temperatures may be 10 percent or less of normal. An associated problem is surface creepage failure due to excessive amounts of carbon dust resulting from rapid wear of the brushes.

Exact chemistry of rapid brush wear is not known. The behavior of the brush and commutator is such that a heavy dark film builds up very quickly on the surface of the commutator creating a high resistance barrier to the flow of current between the brush and commutator. This soon breaks through and causes a low resistance spot concentrating a large amount of the current in a small area which starts to burn. Several of these spots may start simultaneously. The broken film and burned spots cause

(Continued on page 78)

Terrain at the Helen Mine is rugged

Long Hole Drilling and Funnel Mining at the Helen Mine

Efficient Breaking and Handling Method Devised to Mine Large Block of Iron Ore

By C. M. BECK
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Algoma Ore Properties, Ltd.
Sault Ste. Marie, Ontario

THE Helen Mine, located on the Michipicoten Iron Range in Ontario, is owned and operated by Algoma Ore Properties, Limited, is a subsidiary of the Algoma Steel Corporation, Limited. It is 120 air miles north of Sault Ste. Marie and is served by the Algoma Central and Hudson Bay Railway.

The ore is Siderite running about 35 percent Iron in the form of iron carbonate. When crushed to ¼ in. mixed with 2½ percent coke and sintered, it loses 30 percent of its weight as carbon dioxide, and is converted to a sinter containing (53 to 54 percent combined Iron and Manganese) 51 percent Iron and 3 percent Manganese.

This product is unique among lake ores in that it contains about 10 percent calcium and magnesium oxides. The self-fluxing nature and the structure of the sinter make it a very desirable blast furnace feed.

The sinter is shipped 180 miles by rail to the furnaces of the Algoma Steel Corporation at Sault Ste. Marie, or eight miles to Michipicoten Harbor, where it is loaded on lake vessels for lower lake ports.

This article describes the mining of Block II at the Helen Mine. The design of the method permits all the broken ore to be carried by gravity to a crusher. The total direct cost of handling broken ore to the crusher and secondary breaking has varied from 6 cents where all the ore was broken by long hole drilling to 18 cents where ore was slabbed off the old open pit walls by churn drill holes with very heavy burden. After crushing the ore is carried to the surface by belt conveyor.

The Block contains 3,750,000 long tons. One quarter of this will be broken with churn drill holes. The balance will be broken by long hole drilling. We started with diamond drills and soon after converted to tungsten carbide drilling.

Development of Block II

Block II is 450 ft long and varies in width from 60 to 180 ft. The ore strikes from East to West and dips 70° to the South. This area had already been open cut mined to a depth of 150 ft. The general plan was to open a slot on each end of the block, then retreat to a 100-ft pillar in the middle. The object was to funnel this block of ore to a 40 by 48-in. Allis-Chalmers crusher located 875 ft below the open cut floor.

Ore immediately below the pit floor was mined by 9-in. churn drill holes 150 ft long. Below this, mining was by long hole drilling from sub drifts in the ore. Some additional ore had been left on the North wall above the open pit floor. This will be mined by churn drill holes from the original surface. The following tabulations show the vertical distance occupied by each type of operation.

Operation	*Vertical Distance*
Recovery of Surface Ore	150 ft
Churn drilling from Open Pit Floor	150 ft
Long Hole Mining	475 ft
Undercut and Silling Out	50 ft
Ore Passes and Blasting Chambers	150 ft
Crusher	55 ft
	1,030 ft

The total ore to be recovered is 3,750,000 long tons.

The following is a summary of the development work necessary to prepare this block.

The section to be mined by long hole drilling was developed by three raises. From these, eight by eight-ft sub levels were driven around the block and across the middle of the 100-ft pillar. Sub levels are at 70 to 75-ft vertical intervals.

Driving of drifts was done by Jack-legs and 48-in. scrapers with 20 and 30 hp electric hoists. On the West end, where the ore was wider than 130 ft an extra drilling drift was driven down the middle of the ore. On the East end where the ore was less than 130 ft wide drifts were necessary on foot and hanging wall only. Two of the above three raises were at the extreme ends of the orebody, and from these slots were taken out by long hole drilling to make a breaking face.

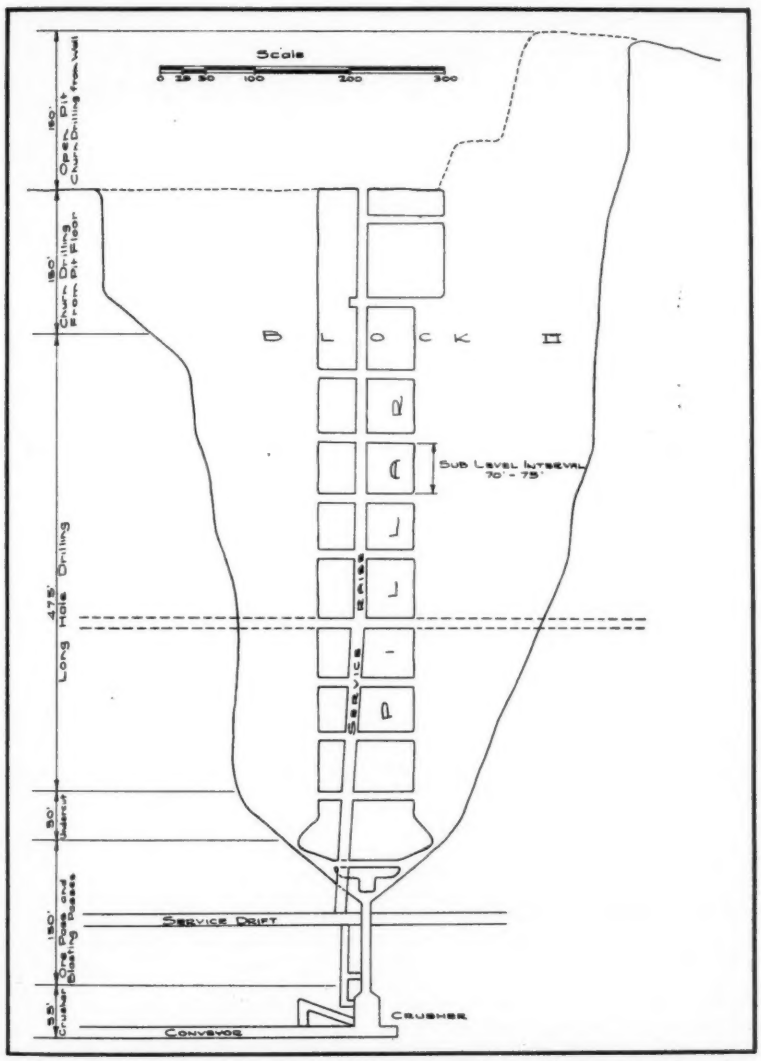
If we were developing this block today, we would probably mine the maximum width of 180 ft from two drifts only. We would also drill holes up as well as down and increase the sub level interval.

Mining

The mining sequence and tonnages involved are shown below.

A total of 913,000 tons (24 percent) will be broken by nine-in. Churn Drill holes drilled to 150 ft. The balance will be broken by long hole drilling. Long holes were drilled at the start with diamond drills but gradually a change was made to tungsten carbide drilling. The first carbide holes were two in. in diameter. This was increased to 2⅛ in. when greater clearance was required between rods and the wall of the hole, to improve sludge removal. All drilling is now done with carbide bits except where drill core is required for sampling or geology.

(a)	Undercut and silling out	25,000 tons
(b)	Mining slots at each end of the block	149,000 tons
(c)	Radial long hole drilling from sub drifts	1,939,000 tons
(d)	Churn drilling from bottom of open pit	366,000 tons
(e)	Churn drilling from walls of open pit	547,000 tons
(f)	Pillar blast	724,000 tons
		3,750,000 tons



Longitudinal section shows relative positions of crusher, sublevels and portion of Block II which was churn drilled

Except for a small area at the East end, where the open cut had not advanced to the ore limit, thus requiring up-holes, all drilling was below the horizontal. Techniques and equipment developed in drilling the few up-holes required, such as a rod holder and a cap to prevent sludge from running back to the drill, have encouraged the inclusion of up-holes in new layouts.

Blast Hole Drilling Equipment

A great deal of testing has been done and still is in progress and we have made many changes. There seem to be no general rules for what is the best equipment for all ground. What suits one mine does not necessarily suit another but at the time of writing the following equipment was in use:

Machines—Gardner Denver CF99 — four-in. wet drifter with six-ft aluminum shell.

Rods—Made by Joy (Craig) from Atlas Nushank and Chippewa 1⅛-in. diameter hollow round four ft long with reverse buttress thread (nickel steel). Rods are reconditioned once by the Mine.

Couplings — Joy (Craig) 1¾-in. O.D. case hardened with flats for wrench grip with reverse buttress thread.

Bit Adapters—Joy (Craig) 1¾-in. O.D. case hardened with flats for wrench grip. The male end has a lamp bulb thread to take the bit and

the female end has a reverse buttress thread to fit the rods.

Chuck Adapters—Gardner Denver 1¼-in. diameter hollow round. We are now testing 1½-in. diameter with satisfactory results.

Bits—Timken DC 528CS—2⅛-in. diameter tungsten carbide with lamp bulb thread. Timken three in. diameter and 3¼-in. steel bits are used for casing, 2⅜-in. to two in. diameter bits in ⅛-in. gauge changes, are used in very abrasive ground.

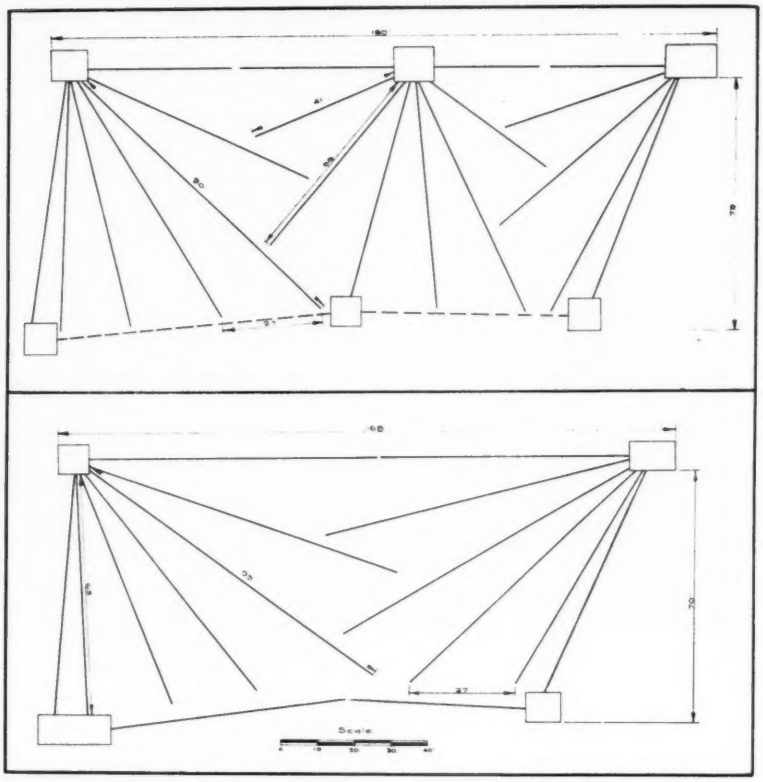
Performance Figures

During the early stages of mining, a great deal of experimental work was necessary for layout patterns and equipment. Men had to be trained. The following figures represent present performance. The ground allows a drilling speed of 10 to 14 in. per min with a 3½-in drifter. Ten cu ft of ground weighs one long ton.

Drilling—One hundred twenty-four ft per machine drill shift (one man) July 1 to 15, 1954. Five hundred twenty-nine ft per bit (Timken Bit) year 1953. Size of Hole—2⅛ in.

Equipment Life—"O" Rings—46 ft. Couplings—179 ft. Bit adapters—1186 ft (1½-in. under test have already exceeded 2500 ft). Chuck adapters—1072 ft ("O" Ring Shanks). Four-ft Drill Rod 240 ft of hole per new rod issued.

Burden—*Slots:* Drifts are slashed to allow drilling three holes spaced at six-ft centres. Distance between rows is five ft. *Rings:* The distance between rings is five ft. Maximum toe spacing is 23 ft measured at right angles to adjacent hole. Holes in adjacent rings are staggered. Vertical distance between sub drifts is 70 to 75 ft giving a maximum hole length of 125 ft.



Typical ring patterns with three drifts across orebody (top) and with two drifts across the orebody (bottom)

Cost per Long Ton—1953 (8 months) for Ring Drilling—476,000 tons.

Drilling	*Blasting*			*Lbs. explosives*	*Long tons per*
	Lab.	*Explosives*	*Total*	*per long ton*	*ft of hole*
13.2 cents	2.7 cents	5.2 cents	21.2 cents	0.24	4.6

These are direct costs only. Charges for air, water, pumping, hoisting, etc., are not included.

Secondary Blasting and Handling

The funnel mining layout is designed on the theory that if ore flows on an incline the large pieces will tend to rise. The flow in the blasting passes is controlled by Cramp chain gates. When a large rock appears, the flow is stopped and the piece is broken by secondary blasting.

From the crusher a main ore pass was driven which holds about 800 tons. Five blasting passes (three to the West and two to the East) were driven at right angles to the main ore pass. These were driven at angles of 40° to 42°, and tap the bottom of the stope. This angle is very important. If the raise is too flat the fines build up. If it is too steep the flow is too fast and the large rocks do not rise. Each is equipped with a Cramp chain gate consisting of six 3¼-in. chains, 18 ft long weighing 2400 lbs each, operated by 14-in. air cylinders five ft long. A blasting drift taps each pass above the chains. From here the miners inspect the rock, operate the chain gates and do the blasting. Another opening into each pass is provided at the brow where the ore pass opens out into the bottom of the stope.

A crew of six to eight men operates the passes when the ore is well broken. More are needed for coarse ore. A steady flow of 400 long tons per hr to the crusher can be maintained with blast hole rock. Very coarse churn drill ore will decrease this rate.

The following points on operation are important:

(1) Ore passes should not be allowed to run too fast or too long. Single heavy flows of rock let large pieces pass through under the fines.

(2) Flat rocks will slide along the bottom of the pass and will not be seen.

(3) Churn drill muck slows the performance.

(4) A high proportion of fines causes trouble.
   a) Large rocks are not seen.
   b) If moist they hang up.
   c) If too wet they cannot be stopped.

(5) Where the stope is broken to surface, heavy rain will stop production.

COST OF HANDLING AND SECONDARY BLASTING

Period	*Long Tons*	*Labor (cents per ton)*	*Explosives (cents per ton)*	*Total per Long Ton (cents per ton)*
1. July 1/'51-Dec. 31/'52	1,332,230	3.42	2.43	5.85
2. Jan. 1/'53-Dec. 31/'53	875,870	5.75	4.15	9.9
3. Jan. 1/'54-June 30/'54	356,960	9.94	8.26	18.2

These are direct costs only. Charges for air, water, pumping, hoisting, etc. are not included.

During the first period all the ore was broken by long hole drilling. During this period there was some delay when large rocks got past the blast-

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Climax test engineer (left) and a visiting engineer gather information in test stope

Testing Drill Steel at Climax

Two-Year Experience Proves Worth of Careful Test Program

By MAX GELWIX and JOHN W. GOTH

Planning Engineer — Metallurgist

Planning Department

Climax Molybdenum Co.

MANY authorities have expressed the thought that the true test for drill steel performance is actual service conditions in the mine. Many attempts have been made to duplicate these service conditions in the laboratory with no great success. With these thoughts in mind, the Climax Molybdenum Co. has evolved a testing program under the supervision of the Planning Department which includes testing drill steel, drill bits, and rock drill performance and maintenance under actual service conditions. Many interesting observations have been obtained from the performance data thus far available. Although many types of data are being obtained through this program, this article will consist of observations made on the ⅞-in. hexagonal hollow drill steel sections.

The Planning Department functions as a service department by cooperating with all operating divisions on special engineering assignments and conducting test work in both the mine and mill. It is staffed by a group of seven men including practical mining men with extensive experience in their field and graduate civil, metallurgical, and mining engineers. The testing of drill steel and related materials is but one of a number of functions of this department.

This article is presented not with the thought that we have solved the problems pertaining to drill steel and its service life, but rather that observations of what has occurred during the present testing program may be of assistance to others experiencing similar difficulties. This report is based on practical test data which have been accumulated with the assistance of metallurgical reports received from various sources. It is hoped the data produced may save duplication in test work and initiate new methods and procedures that will increase the service life of the lighter sections of drill steel.

Testing A Full Time Job

This testing program was initiated approximately two years ago. At that time, there were two men in the Planning Department. It was apparent from the consumption of materials underground and the special problems arising from the mining operations that an accurate record of service life for the various mining materials would be in order. It was also realized that the company would gain from a test program which would indicate the average service life of these materials and give some idea how it could be improved by examining their performance and reasons for failure. To date the program has proven valu-

able. Mining costs have been reduced as a result of an accumulation of improvements throughout the operation. Now at least one test engineer spends full time testing drill steel, drill bits, and rock drill performance.

At first, difficulty was experienced with the testing program. Engineers were working with contract miners to test new material and equipment. This procedure was slow and cumbersome in that it was in direct conflict with normal contract schedules. To accelerate the program, the department obtained the use of an old drift for a test stope. This drift was located close to the mine adit, was well ventilated, and enjoyed constant air pressure for the test machines.

The test drift was surveyed in ten-ft sections with the rock in each section classified according to its comparative hardness. This arrangement enabled our engineers to drill from four to five times more footage over a given period of time than an average contract miner. The test engineer spaces his drill holes in such a manner that alternate sets of steel and bits can be tested under comparable rock conditions for consistent results. The test stope has proven beneficial in many respects. It has greatly accelerated the testing program and has allowed development engineers from other companies to accompany their products underground to observe performance without interfering with normal mining operations.

Bulk of our test work with drill steel is conducted with the thought that the present trend in the mining industry is to lighter rock drills and a smaller section size of drill steel with smaller bits. The standard rock drill used with the ⅞-in. hexagonal drill steel is a 2¾-in., 90-pound stoper with a 2-ft steel change. One and one-half-in. carbide insert bits are used for drilling, and air pressure in the test stope from 85 to 87 psi is standard for consistent drilling results. The 2¾-in. stoper has been selected because it is the heaviest machine used with ⅞-in. hex drill steel. It has been found that the drill steel life in smaller machines such as feed legs far surpasses that of the stoper. Where the service life of drill steel has been approximately 200 ft drilled before steel failure in a stoper, experience shows an increase of two or three times the steel life in a feed leg machine for the same steel.

Heat Treatment Important

The actual metallurgical examination of drill steel is restricted at Climax. Observations are limited to visual examination and Rockwell hardness testing. Increased experience with drill steel indicates the hardness readings, within specified limits, give good correlations with service life and provide indications of the cause for premature failures. Many facilities are available for complete metallurgical examination of drill rods. These include the Climax research laboratory in Detroit, Mich., the laboratories of steel companies, and the laboratories of companies in our immediate area. Good cooperation with these people and access to their data has been very valuable to our program.

We are attempting to improve drill steel life by the development of three important factors governing drill steel; namely, heat treatment, design, and alloying constituents. The standard alloy steel used at Climax is the 52100+Mo alloy. Plain carbon steel is not used for hollow drill rods because previous testing has shown the alloy drill rods are preferable for our operating conditions. The relative merit of alloy drill steel compared to carbon drill steel has been discussed in previous publications*, so it will not be discussed further here.

Heat treatment of 52100+Mo drill steel has been found to be a most important factor in maintaining maximum service life of the steel. Heat treatment and fabrication is done at the mine shop in Climax. Our hardening heat treatment has recently been revised because the rate of cooling the 52100+Mo steel is very critical. Previous heat treatment consisted of heating the steel to 1650° F., cooling in a mild air blast, and tempering at 700° F. for one hour. Using this heat treatment, we were plagued with inconsistent hardness in the steel. The greater percentage of the steel would retain a hardness range of Rc 38-42 which we consider most desirable. Other heats would retain a higher hardness of Rc 50-55 which would be sensitive to premature failure. It was brought to our attention that the mild air blast could produce a maximum hardness on intermittent heats of steel. The present practice consists of cooling the steel from 1650° F. in still air and tempering at 700° F. It has been found that tempering will not appreciably affect the hardness of a steel which has been quenched in still air; however, when the same steel is quenched in circulating air, and an extremely hard structure is formed, the steel will soften on tempering and yet retain a hardness which results in premature failure. The revised heat treatment has been used for the past two months with no brittle failures occurring in the steel or other complications arising from the new heat treatment.

It is necessary to standardize the heat treating procedure at Climax because the longer drill rods will be reprocessed after initial failure until the steel has been entirely consumed. One eight-ft rod could conceivably be processed through each two-ft section change until it finally becomes a starter section, 30 in. in length. This of course depends upon the condition of the steel when it reaches the drill shop and the location of the failure. Control rods are now being checked from each new heat of steel to be sure the heat treating procedure will produce the desired hardness. Excessive hardness in drill steel usually causes premature failures either at the fillets in the collar section or at the threat end. These rods fail in fatigue and are called "notch sensitive" because the failures are usually located in a highly stressed area which is susceptible to fatigue similar to an actual notch cut into the drill rod. The spalling of the threads after a short period of drilling time is very typical of the hard structure. Longitudinal cracks have also occurred in the shank end sections in the machine chucks. These appear to occur only on the very hard drill rods. It is believed the revised heat treatment will practically eliminate the brittle structure and thereby greatly improve the service life of the steel.

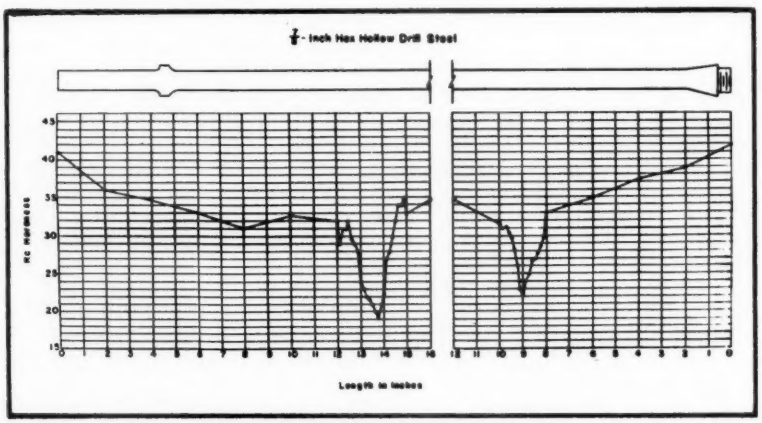


Fig. 1. Hardness readings showing the "Metallurgical Notch" at the end of the heat-treated part of the rod

Study Metallurgical Notch

When conditions are such that no premature failures occur in the steel,

* Case History No. 31, "Alloy Steels Pay Off" Climax Molybdenum Company.

TABLE I

Drilling Length a Section of Rod in ft	Average Footage Per Rod Before Failure	
	Standard Heat Treatment	Revised Heat Treatment
8	78.7	305.0
6	83.7	414.8
4	195.5	451.7

many failures will originate at the metallurgical notch or soft zone. The heat treating furnace is not large enough to harden the rod sections their full length: consequently, the ends of the rod sections are heated approximately 12 to 14 in. for hardening. As the heat is conducted down the drill rod, there will be a point where the rod reaches a maximum softness. This is termed the "metallurgical notch." Figure 1 shows a typical notch zone for both ends of a drill rod. These notches are typical of a heat treatment where an attempt is made to minimize the notch zone by inserting the steel into the furnace a specified length and holding until the additional rod length approaches furnace temperature. As indicated in figure 1, the notches are very sharp. This soft zone appears to have a definite "notch" effect upon the fatigue life of the drill steel.

Standard heat treatment has been modified slightly and has shown an increase in service life before failure in the notch zone. It was not a planned procedure. The heat treat foreman personally decided to place the steel its maximum length in the furnace at the beginning of the heat treating operation. This modified the notch area in the following way: the zone of maximum softness was increased a length of approximately four in. before again increasing in hardness. This is about four times that of the sharper notch shown in figure 1. The actual soft zone was also moved down the rod about three in. The notch zone typical of the revised heat treatment would actually show a minimum hardness for a length of approximately four in. beginning 15 in. from the shank end and increasing again in hardness 19 in. from the same end. Indications are that this type of notch gives a better service life as shown in Table I.

Temperatures Checked

Service life of drill steel will vary according to the length of the rod. Two-ft changes are used, and an eight-ft drilling length is the maximum used for practical purposes. Table I indicates the service life in footage drilled before the rods failed in the metallurgical notch zone. A failure in the notch zone can be easily determined by hardness testing. These data are compiled using the average of several rods for each sectional length.

It has been noted that the revised heat treatment has moved the metallurgical notch approximately four-in. down the rod.

It also should be noted that failures in the metallurgical notch are most prevalent at the shank end of the rod. No definite conclusions have been made as to why the service life is improved using the revised heat treatment. However, it does seem significant that the soft zone is moved away from the machine and the failures occur a greater distance from the shank end.

Having no quality control department as such at Climax, we keep a very close check on drill steel heat treatment and fabrication. The drill steel foreman observes any irregularities in the heat treating operation and uses an optical pyrometer for a daily check on steel temperatures. An effort is made to keep a deoxidizing atmosphere in the furnace to control the decarburization of the surface of the drill steel as much as possible. The furnace temperature, especially for the hardening treatment, has been found to be very important to proper drill steel life. Experience has shown that a variation of 50° F. in the temperature of the steel will show a definite variation in the final hardness. If the temperature is lowered to 1600° F. rather than 1650° F. before cooling the steel in still air, the steel will show a marked decrease in hardness. If a major deviation in temperature between the steel and control indicators is noted, the temperature is checked by a potentiometer and the temperature controls adjusted accordingly. As a result of improved control, we have found no indications of inferior drill steel because of poor shop practice.

Collar Redesigned

The upset collar on ⅞-in. hex drill steel has proven to be the principal point of early failure. Failures have been prevalent in the fillets on either side of the collar; and since the present testing program was initiated, the collar design has been continually

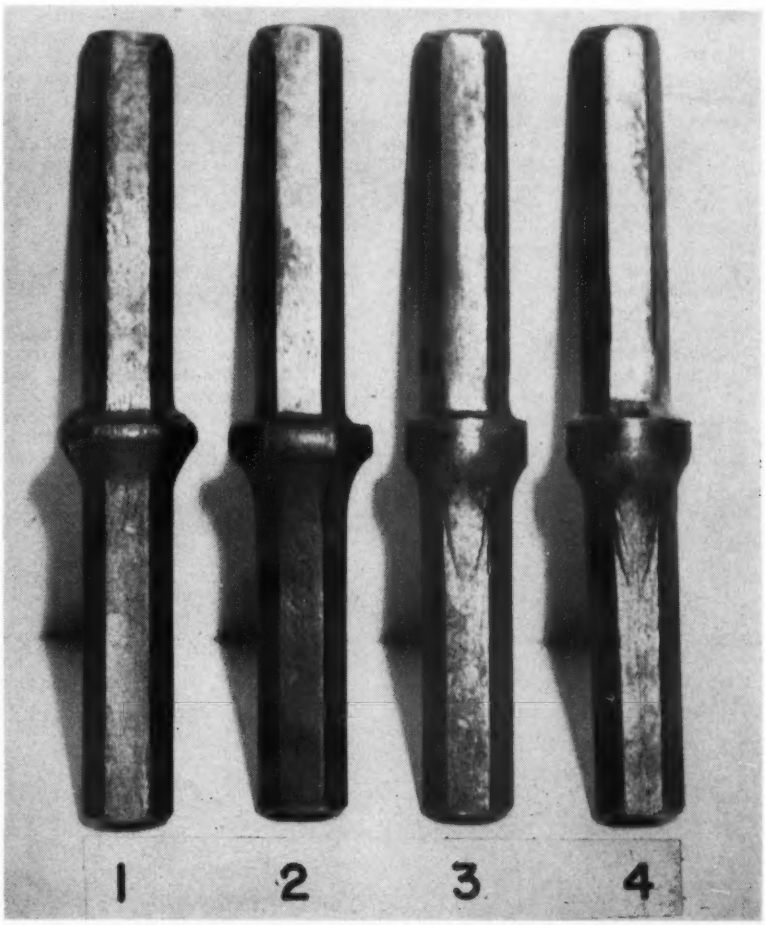


Fig. 2. Modifications in collar design showing the initial design on rod 1, at left

TABLE II—EFFECT OF FILLET SIZE ON ROD LIFE

	3/16-in. Fillet		1/32-in. Fillet		4/32-in. Fillet		3/8-in. Fillet	
	Ave. Footage Drilled Per Rod	% Failures in Fillets	Ave. Footage Drilled Per Rod	% Failures in Fillets	Ave. Footage Drilled Per Rod	% Failures in Fillets	Ave. Footage Drilled Per Rod	% Failures in Fillets
Eight-Ft Drilling Lengths	41.1	44.4	16.7	75	94.5	50	....	None
Six-Ft Drilling Lengths	83.9	57.1	....	None	....	None	....	None
Four-Ft Drilling Lengths	146.8	50	16	50	374	25	....	None

modified. The steps that have been taken thus far are shown in figure 2. The collar on the left is the original pear shaped collar before modification. Failures occurred in the sharp fillets on both sides of the collar with the failures about evenly distributed between the two fillets. The collar section was then modified to Rod No. 2 in figure 2 which greatly increased the radius of the fillet on the side opposite the chuck. This increased radius has eliminated the breakage on this side of the collar. The new design is presently being used at Climax.

A major remaining problem is the collar fillet adjacent to the machine. The rods are used in direct striking drills and high stresses are formed in the fillet at the base of the collar. The first test work completed under the present program indicated that 44 percent of the steel failed in this fillet. Experiments have been conducted with a varying radius in this fillet ranging from 1/32 to 3/8 in. Using the smallest radius, an average of 16.7 ft was drilled per rod before failure and 75 percent of the rods failed in the fillet. With the radius increased to 1/32, only 25 percent of the rods failed in the fillet and averaged 89 ft drilled before failure. These results indicated the possibility that further increases in the fillet radius might be beneficial, and new modifications were made with this thought in mind.

The present experimental collar design is Rod No. 4 in figure 2. This rod has a 3/8-in. radius in the fillet adjacent to the machine. At this time more than 20 rods have been tested using the design without a single failure in the fillet. A similar radius was ground in the machine chuck bushings so the fillet is seating properly with the chuck. Table II indicates the increase in footage drilled and the percentage decrease in the number of failures in the fillets as the collar design was modified.

Although the increased radius of the fillet on the machine side of the collar has indicated a vastly improved service life, it has also presented additional problems in machine chuck design. Figure 3 shows the machine chuck and bushing assembly that is now being used at Climax. The present bushings have given a satisfactory service life. The design of this bushing is now being modified so it may be used with the 3/8-in. fillet. Figure 4 shows the design changes we have made to date. The bushing at the left is the standard now in use. Our attempts to use the same bushing with a larger fillet, as shown by the second bushing in figure 4, caused premature failures at the fillet. The third bushing pictured is now being tested. This bushing has a deeper collar section at the top to support the larger fillet radius. To date, this design has indicated a superior service life when compared to the standard bushing now in use. More modifications will be necessary in the design of both the drill steel and the rock drill, but the resulting effect on drill steel life will be very beneficial.

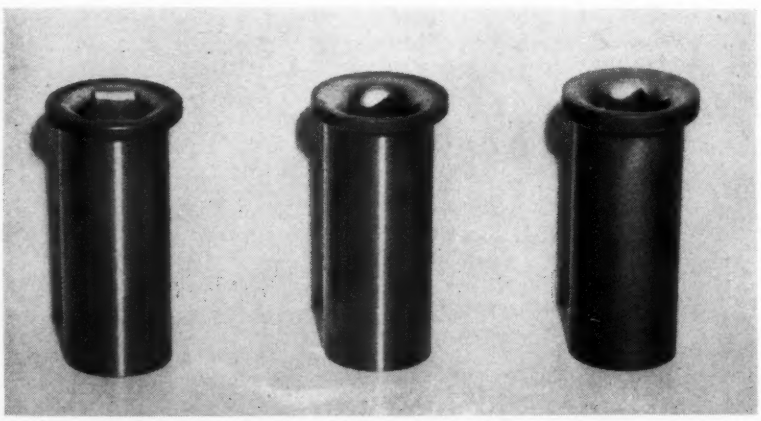


Fig. 4. Modifications in bushing design showing the initial design on the left

Benefits Just Beginning

Test work with different alloy steels has been very limited at this time. However, the data thus far have given sufficient indication that more testing along these lines is warranted. Alloy carburized steel has been tested but premature failures have occurred in the fillet at the collar and at the thread ends. These failures appear to be more mechanical in nature than affected by varying alloy content.

By introducing the present testing program and attempting to improve the service life of drill steel through

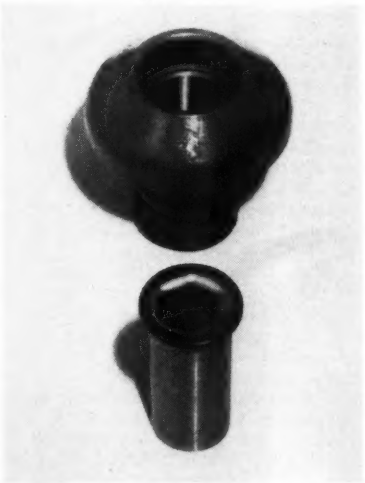


Fig. 3. Rock drill chuck and bushing assembly

the investigation of modifications in design, heat treatment, and alloying, definite improvement has been made in the life of our drill steel. We feel that we are just beginning to show results from the testing program. Accurate records have been established to show what can be expected from the standard steel under normal service conditions. We are just arriving at the position where we can assist the mine department by predicting the cause of irregularities that arise in drill steel performance and by applying the knowledge accumulated during the testing program to eliminate these irregularities.

Greatest improvement in performance of the steel can be traced to modifications in design and heat treatment. The importance of heat treatment for hardening the steel to desired properties should not be underestimated. Proper metallurgical investigations and heat treating techniques will provide the properties desired for a given alloy steel. The design of the upset collar for drill rods has been of the greatest importance to us. A greater share of the failures occurring in this area have been elimi-

TABLE IIIa

Rod Length-ft.	Feet Drilled	Location of Failure
8	22	Fillet at Collar
8	63	Fillet at Collar
8	116.5	Met. Notch Zone
8	110	Met. Notch Zone
8	25	Met. Notch Zone
8	40.5	Fillet at Collar
8	32	Met. Notch Zone
8	39	Fillet at Collar
6	64.5	Fillet at Collar
6	69	Met. Notch Zone
6	132	Fillet at Collar
6	32	Fillet at Collar
6	107	Fillet at Collar
4	223	Fillet at Collar
4	327	Met. Notch Zone
4	70.5	Fillet at Collar

Av. feet drilled per rod for all lengths—92.1.

nated and this has greatly increased the life of the drill steel.

Collar Failures Eliminated

Table IIIa shows the service life and types of failures for the steel before the modifications in heat treatment and design were started. Table IIIb shows the service life and failures after the modifications were put into effect. The data in these tables indicate that the improvement in the service life of our initial drill steel has been increased by better than 500 percent. However, we wish to emphasize that these results are from test material. Not all of the benefits of design change have been placed in operational use because of needed changes in machine design; however, some of the design modifications are now in use underground as shown by Rod No. 2 in figure 2. These design modifications have confirmed the test work. It is significant to note that there were no collar failures in Table IIIb, also significant is the increased footage obtained before the steel failed in the metallurgical notch zone. These two factors have been the most significant in the improvement of drill steel life at this time.

TABLE IIIb

Rod Length-ft.	Feet Drilled	Location of Failure
8	366	Thread End
8	112	Thread End
8	251	Thread End
8	431	Met. Notch Zone
6	672	Thread End
6	579.5	Met. Notch Zone
6	598	Thread End
4	537.5	Met. Notch Zone
4	806	Met. Notch Zone
4	384	Met. Notch Zone
4	447	Thread End

Av. feet drilled per rod for all lengths—471.3.

Exchange of Information

The tables show that as the failures at one section are minimized they are transferred to another location, and we benefit with an increase in service life. There are many theories on drill steel fabrication which will require extensive future work to separate the good and the bad. The present problem is to adapt the stoper and feedleg chucks to accommodate the proven ⅜-in. radius fillet; and when this is accomplished, thread and metallurgical notch failures will increase. When a suitable bit attachment is devised, it will then be possible to investigate the benefits of a full length heat treatment to completely eliminate the metallurgical notch. These are lines of thought to pursue on the use of 52100+Mo steel. Other alloy steels will also be investigated and the work with these alloys will give us an indication of the effect that steel microstructure has on its service life.

The field of endeavor to produce a better drill steel is challenging. The importance of drill steel to the mining industry is receiving greater recognition. It is hoped the reader will benefit from the data presented. Exchange of information within the industry is necessary if its problems are to be solved in minimum time.

The authors wish to thank the Climax Molybdenum Co. for permission to publish this paper. The cooperation received from the management and the mine department has made the testing program possible. The assistance of various companies that have conducted metallurgical investigations for the program is also greatly appreciated.

Long Hole Drilling

(Continued from page 58)

ing chambers and had to be blasted in the crusher or crusher chute.

During the second period a portion of churn drill ore from the pit floor was handled. More men were used on the passes which were run more slowly and carefully to cut down crusher delays. While this increased the handling cost it did improve the production per shift.

During the third period we slabbed some ore off the old open pit walls. Due to the difficulty of locating the churn drill some of these holes had as much as 80 ft of burden. This naturally produced very rough muck which raised the secondary handling costs.

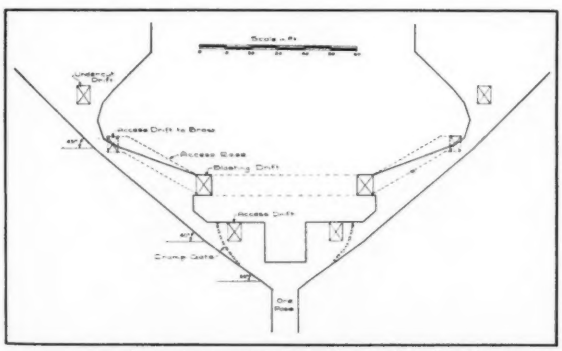
Time and Capacity

The first work off the main levels was undertaken in January 1950. The crusher was operating in June 1951. Production for the next few months was from undercut and slots and varied from 20,000 to 50,000 tons per month. By November 1951, a production of 75,000 tons was reached. The biggest average daily production for a week was 5260 tons. The biggest average daily production for a month was 4350 tons.

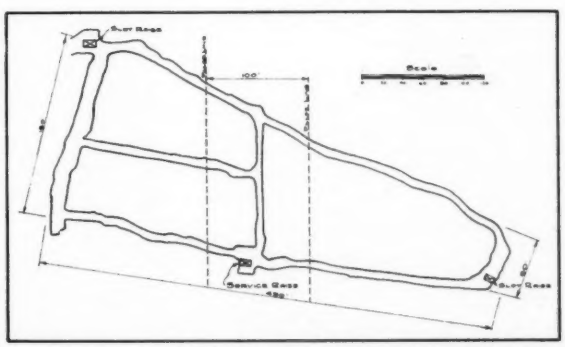
Present Position

There is still some ring-drilled ore to be extracted from Block II. The pillar also remains as does some of the ore to be slabbed off the walls of the Open Pit.

The mine is producing 6000 tpd of which a little more than half comes from Block II.



Chunks too large for crusher are broken at level of blasting drift before they reach the cramp gate



Sublevels were developed by driving around ore perimeter and across center of the pillar with a drift down the middle

The availability of maintenance personnel has a decided effect on delay time from equipment failures

A Report of the Mechanical Mining Committee Presenting the Cost Experience of Several Coal Companies in Maintenance, Repair and Rebuilding of Continuous Type Mining Machines

W. J. SHIELDS
W. E. HESS
E. H. JOHNSON

Continuous Machine Maintenance Costs

MAINTENANCE of equipment is one of the biggest problems confronting coal mine operators today. Especially is this true in continuous mining where a breakdown of any part of the unit results in idleness of the full complement of equipment in the section. Because of its importance to the coal industry the Mechanical Mining Committee inaugurated a study nearly two years ago which was intended to cover the cost of labor and material to maintain a continuous unit in operation. The first step in this study was to contact a number of coal companies asking their experience in continuous mining, with particular reference to delays and their causes. Records on 29 operating units were submitted and an examination of this data revealed the fact that the continuous machine in itself was not the chief offender—other delays in the section caused by service haulage, roof support, supply handling, etc., were all large contributors to lost production time. A complete report on this phase was published in the September 1954, issue of MINING CONGRESS JOURNAL and the accompanying tabulation is a summary of the delays as given in that report.

Following this publication it was the opinion of the Committee that their study should be continued, but should deal only with the delays occurring to the continuous machines (eliminating the auxiliary operations) and to determine if possible what corrective measures seemed to offer the most promise. Since machine breakdowns in general are due either to a failure of the equipment itself or to improper methods of application, it was felt that a report would be of value if it were directed toward two objectives:

A. To encourage better design and materials in continuous machine construction, to correct weaknesses developed by actual operation and to consider in the design the accessibility of parts that might need replacement.

CAUSES OF CONTINUOUS MINING DELAYS
EXPRESSED IN PERCENTAGE OF TOTAL SHIFT

Mine	Number of Continuous Machines	Machine Delays	Haulage Delays	Roof Support	Supply Handling	Other Delays	Total Delays
No. 1	3	9.99%	5.11%	1.29%	3.33%	3.92%	23.64%
No. 2	4	10.60%	3.00%	19.62%	2.05%	2.65%	37.92%
No. 3	5	4.20%	0.80%	16.90%	2.10%	6.00%	30.00%
No. 4	10	10.49%	5.03%	4.20%	.....	2.70%	22.42%
No. 5	5	18.00%	6.00%	.....	.....	1.00%	25.00%
No. 6	2	8.25%	4.70%	23.20%	0.60%	5.40%	42.15%
Average	..	10.26%	4.11%	13.04%	2.02%	3.61%	33.04%

B. To improve methods in the operation of the machine, to set up practical maintenance programs, to stress the need for proper supervision and to insure that the machines will be used in the seam conditions and in the class of service for which they are designed.

Reducing On-Shift Breakdowns

In the foregoing summary of the Committee's objectives, the major item or at least the one that lends itself to immediate attention is preventive maintenance. Setting up a maintenance program for continuous miners requires careful planning and execution as the number of breakdowns and the delay time can be influenced by the following factors:

(1) Availability of maintenance personnel.
(2) Availability of supplies for repairs.
(3) Spare unit assembly.
(4) Maintenance time available.
(5) Proper lubrication.
(6) Systematic inspection.

Availability of maintenance personnel can have a different meaning at each individual mine, depending on the adopted plan. Some mines provide a mechanic for each crew, who is an integral part of the crew, and this now seems to be the coming standard practice. While on duty, the section mechanic will lubricate the machine, make minor repairs and adjustments while the machine is idle, and make inspections.

Availability of supplies for repairs can be very costly especially when spare parts must be provided for several machines. A small central supply depot underground may cut down this cost, but it is well to have on the section a variety of hydraulic hose, chain blocks, conveyor chain repairs, cutting bits, etc.

Systematic inspection can be of utmost value in preventing breakdowns

Spare unit assembly method of repairing breakdowns is increasing in favor although on-the-spot repairs constitute the major portion of maintenance work. The replacement of an entire unit can sometimes be made in much less time than that required for on-the-job repairs but the chief drawback is the relatively large investment required for the extra units.

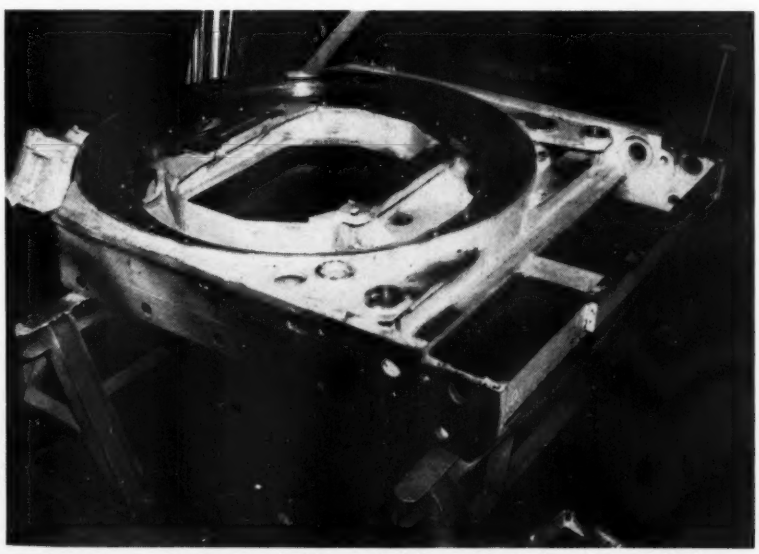
Maintenance time available depends entirely on the number of working shifts per day and the scheduled start of the particular shifts. If it is a three-shift operation, the regulation of portal time so the crews can change on the section, can provide some spare maintenance time. Otherwise the only time available is during timbering, rock-dusting, and car changes.

Proper lubrication can be the means of preventing major breakdowns. It is well to entrust this to people who are vitally interested in preventing breakdowns, such as, the maintenance personnel. The possibility of installing centralized lubrication is now receiving quite a lot of attention, especially when three-shift operations are in effect.

Systematic inspection can be of the utmost value in preventing both major and minor breakdowns. The results of all inspections should be made available to both the operating and maintenance personnel.

Spare Equipment and Rebuilding

A long range maintenance program for continuous machines should provide a spare unit for a prescribed number of operating units. Operators are reluctant to do this, because of the amount of money involved for spare equipment; however, the policy is sound. Experience will dictate rebuilding scheduling. Machines working in development, where severe conditions exist, will require quicker rebuilding than machines on retreat. In any event, close observance should be made of repeated breakdowns and from this can be determined the amount of tonnage that can be expected before rebuilding is indicated. This method of rebuilding will be governed by the size of the operation and the facilities available. Where large central shops on the outside are available and a crew of trained personnel can be assigned to this work, it will prove to be most advantageous. Where such facilities are not available, there are any number of commercial rebuilding shops that are available and these shops are doing an excellent job in rehabilitating machines and modernizing them.



Experience will dictate rebuilding schedules and periodic shop overhauls

Case Histories

It can be concluded that there is a very close relationship between maintenance, production, and costs when operating continuous mining. While the maintenance cost of continuous machines is proportionally higher than conventional units, so also is production per man-day higher with this type of equipment. These facts seem borne out by the following accounts from coal companies that have been submitted to the Committee and are made a part of this report. It should be mentioned that all of these accounts cover operations with the so-called "ripper type" continuous machines: subsequent studies to be made by the Committee will include the several later type models that are now coming into wide use.

REPORT ON MINE A

This mine is in the Pittsburgh No. 8 Seam—5½ to 6 ft of coal and 10-13 in. of hard drawslate. The immediate roof tends to subside very quickly after the coal is extracted; the bottom is a fireclay, extremely hard when first exposed, but becomes soft when water is present. Frequent clay veins in the seam present problems—both for the machine cutting and roof control. The roof conditions make it necessary to stop the machine in order to set supports; wood crossbars on four- to five-ft centers. Normally the machine can advance until the operator is under the last inby bar but frequently timbers have to be put up as soon as it is possible to do so.

There are 14 continuous machines in operation, with one extra spare or standby. Each machine retreats a panel approximately 1600 by 508 ft which is developed by four entries driven by track-mounted loading machines. Rooms are worked retreating with continuous mining recovering the room and chain pillars. Each machine works three shifts a day and the following table shows the average delay for 14 continuous machines working a total of 3855 shifts during a six-month period in 1954. The delays are determined from the daily reports of each crew foreman, and though not as accurate as time studies, they do indicate a general picture as far as breakdowns and other delays are concerned.

	Shift Average
(1) Total working time available	6.85 hours
(2) Continuous machine operating time	3.72 hours
(3) Continuous machine delay time	0.44 hours
(4) Delays in section (including lunch)	2.69 hours

	Continuous	*Conventional*
Number of Shifts Worked	3,855	7,812
Tons Produced (Raw)	884,631	2,031,999
Tons (Raw) Per Machine Shift	230	260
Maintenance Labor Cost	$0.19 per ton	$0.16 per ton
Maintenance Material Cost	0.17 per ton	0.12 per ton
Total Maintenance Cost	$0.36 per ton	$0.28 per ton
Rebuilding Labor Cost	$0.03 per ton	$0.03 per ton
Rebuilding Material Cost	0.06 per ton	0.08 per ton
Total Rebuilding Cost	$0.09 per ton	$0.11 per ton
Maintenance and Rebuilding	$0.45 per ton	$0.39 per ton

The maintenance organization consists of one key mechanic and three section mechanics per shift for every three machines operating. One mine electrician is employed on each shift. Each face entry, which normally has three operating units, is equipped with a small shop where parts are stored. The key mechanic is in charge of this shop, and rebuilds chains, jacks, etc., when not trouble shooting on any of the three sections which may require his help. All repairs are made on the working section and only when the machine requires a shop rebuilding is it removed to the general shop on the surface. Maintenance costs are not allocated by machine but to the continuous machines as a group. Following are maintenance costs for continuous and conventional loaders under similar seam conditions.

The tonnage mined by any particular machine before rebuilding is dependent upon the usage to which the machine was subjected. The experience at this mine indicates that machines on retreat require less rebuilding than those on development. For example, one machine driving entries had to be rebuilt after mining only 65,600 raw tons as compared to 290,000 tons by this same machine on retreat. The machines that have had rebuilding experience are the oldest units, being from 3½ to 5½ years in service. The newer machines with improvements and reinforcing have not required any rebuilding as yet. Thus far it would appear, if the machines are kept on retreat, that 300,000 raw tons would not be too much to expect before rebuilding is necessary.

REPORT ON MINE B

This report covers continuous miners operating in the upper Freeport seam with working height of 42 to 44 in. The roof normally is good with only posting required; however, tender roof frequently is encountered and it is then necessary to set crossbars or bolt. The bottom is fireclay, which makes good roadways unless it becomes saturated with water. The coal is of medium hardness with a 1½-in. slate binder. There are no unusual mining conditions which increase normal maintenance on continuous mining equipment.

Four continuous machines have been operating in this area for a period of approximately four years, mining in the room and pillar system. The machines discharge the coal onto the bottom where it is picked up by a mechanical loader and loaded into a shuttle car, which discharges onto the 30-in. belt.

The general maintenance of the mine is planned and supervised by a supervisor of maintenance. A shift mechanic is assigned to each section. All repair work, including replacement of major parts, is done on the section; the only time the machines are brought

MAINTENANCE COSTS

	Continuous Mining	*Conventional Mining*
Number of Shifts Worked	293	293
Tons produced	100,805	72,686
Maintenance Labor Cost	$0.224 per ton	$0.151 per ton
Maintenance Material Costs	0.267 " "	0.081 " "
Total Maintenance	$0.491 " "	$0.232 " "
Rebuilding labor and material	0.122 " "	0.064 " "
Maintenance and rebuilding	$0.613 per ton	$0.296 per ton

CONTINUOUS MACHINE DELAY TIME

Number of Shifts	394
Work time available	2,756 hours
Machine operating time	1,911 "
Machine delay time	274 "
Other delays in section	374 "
Lunch time	197 "

to the surface is for complete re-building which is handled in a central shop. Each machine is rebuilt after mining approximately 150,000 tons on a clean coal basis.

The delays in the following tabulations are an average for three continuous machines and were determined from reports by the assistant foreman on the various sections. The maintenance costs are for a six-months period and compare continuous machines with another mine in the same seam with similar physical conditions that uses conventional mechanical loading equipment.

REPORT ON MINE C

This operation is in the upper or thick Freeport seam which has an average mining height of 6½ ft with a 12-in. bone bottom band, high in ash. The floor is fire clay and the roof is a shale which varies from 0 to 20 ft thick. The majority of the continuous mining is in pillar extraction, recovering chain pillars and small barriers. The roof condition directly affects production as it is difficult to get areas wide enough to effectively break the secondary sandstone. It is necessary to remove coal in small lifts, causing considerable equipment moving.

CONTINUOUS MACHINE DELAY TIME

Number of Shifts covered	3,413
Total face working time available	21,047 hours
Continuous machine operating time	11,832 "
Continuous machine delay time	683 "
Delays in the section or panel	6,826 "
Lunch time	1,706 "

MAINTENANCE COSTS FOR CONTINUOUS MACHINES

Number of shifts worked	3,413
Tons produced	633,278
Tons mined per machine	284,000
Maintenance Labor Cost	$0.158 per ton
Maintenance Material Cost	0.261 " "
Total Maintenance Cost	$0.419 per ton
Rebuilding labor cost	$0.003 " "
Rebuilding material cost	0.015 " "
Total Rebuilding Cost	$0.018 per ton
Maintenance and Rebuilding	$0.437 per ton

There are five continuous machines in operation; each machine loads onto a shuttle car which transports to five-ton mine cars. The data in the following tables cover one year's operation for the five units.

REPORT ON MINE D

This operation is in the Pittsburgh seam with an average height of 74 in. and a draw slate approximately 12 in. thick that is mined with the coal. The continuous machine discharges onto the mine floor and a pick-up mechanical loader puts the coal into shuttle cars. During this operation, 90 percent of the mining was in entry development with 10 percent in pillar extraction on a pocket and wing system.

The following data covers two continuous machines for the first six months of 1954—each unit working three shifts per day. The lost time record from mechanical delays for two units average 19 minutes per machine shift; in addition, there were 39 rebuilding shifts on one of the continuous machines. A summary of maintenance costs (including the rebuilding) for the six months was:

Repair Parts	$0.464 per ton
Labor Cost	0.335 " "
Total	$0.799 per ton

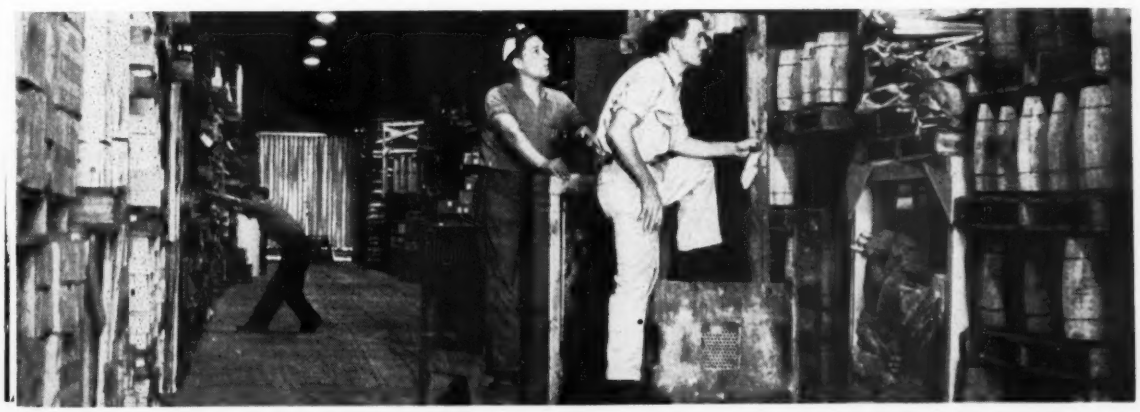
REPORT ON MINE E

This mine is in the Pittsburgh No. 8 Seam, averaging 58 to 60 in. thick, practically level, non-gaseous with 10 to 14 in. of draw slate immediately over the coal, and a soft fire clay bottom. The draw slate is held by four-in. steel beams, placed on 3½ to 4-ft centers. The following maintenance costs are based on the operation of five continuous machines covering the entire year of 1953, and to June 1954.

Repair Parts	$0.248 per ton
Labor Cost (Maintenance)	0.181 " "
Total	$0.429 per ton

Another mine in the same seam and with similar operating conditions reports the following maintenance costs:

Repair Parts	$0.253 per ton
Labor Costs	0.189 " "
Total	$0.442 per ton



Wheels of GOVERNMENT

As Viewed by HARRY L. MOFFETT of the American Mining Congress

THE official calm that has characterized the Nation's Capitol since the departure of Congress was shattered by the news of the moderate heart attack suffered by President Eisenhower late in September.

On the heels of the announcement Cabinet and other high Administration officials quickly hurried back to Washington, to attend a series of meetings designed to make sure that the day-to-day affairs of Government would continue on an even keel during the President's convalescence. That they are doing so is a tribute to the fine organizing ability of the President, who, drawing upon his military background, has delegated much of the responsibility of his office and the authority to make decisions to his lieutenants. Vice President Nixon, thoroughly trained by the President during these first few years of office, has stepped into the breach and is carrying on for the Chief Executive in many matters.

Speculation, of course, became rife among politicos as to the effect of the President's illness upon the forthcoming political campaign. Some were predicting that he might withdraw from the national political scene at the end of this term, thus throwing the Presidential race into a free-for-all among prospective candidates. On September 26 the stock market reflected some of this thinking, taking the sharpest one-day dip since 1929.

Most Cabinet officials freely predicted that the absence of the President while recuperating would not seriously hamper the operations of the Government Departments and agencies. So far as the mining industry is concerned, it is not likely that any changes will occur in policies presently being pursued.

Tariff Negotiations

The State Department has announced that it will participate in a fourth round of tariff negotiations next January with 25 foreign nations. In making its announcement the Department also issued a list of some 1000 commodities that may be the subject of negotiations. It stated, however, that the appearance on this list of a specific commodity "does not necessarily mean that a concession will be offered or made on the product."

Hearings concerning all aspects of the proposed negotiations will be held, beginning October 31, before the Committee for Reciprocity Information. On the same date the U. S. Tariff Commission will also hold public hearings in connection with its "peril point" investigations, to determine the extent to which the United States concessions on listed products may be made without causing or threatening serious injury to a domestic industry.

Included in the long list of commodities that might be the subject of tariff concessions by the United States were the following products of domestic mines: various types of pigments and metallic compounds or salts; firebrick; magnesite; gypsum; pumice; ball and china clays; mica; talc; marble, granite and certain other building stones; manganese ore and concentrates; molybdenum ore and concentrates; ferromanganese; tungsten ores, concentrates, and alloys; ferrosilicon; chromium and ferrochrome; calcium; aluminum and alloys; magnesium; antimony regulus or metal; bismuth; copper in rolls, rods or sheets; metallic arsenic; nickel in pigs, ingots or cathodes; and import taxes on copper-bearing ores and concentrates.

Under the recently renewed and revamped Trade Agreements Act, the U. S. Government has authority to cut all tariffs 5 percent a year for the next three years, and to roll back to 50 percent of the value of an imported item any tariff which is now above that level. U. S. negotiators are said to plan to offer the full 15 percent slash in a "package," spread over three years, rather than negotiate each 5 percent reduction separately. It is expected that the forthcoming hearings will bring forth a storm of protest from affected domestic industries and result in a trimming of the list to be considered in the negotiations.

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Washington Highlights

TARIFF: Negotiations announced
OIL IMPORTS: To be restricted?
COAL EXPORTS: Program ends
RENEGOTIATION: Act under study
MINING LAW: Regulations being drafted
MATERIALS BARTER: Program to be enlarged
DMEA CONTRACTS: 809 let in four years
COAL FUTURE: Bright says Wormser

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The January tariff-cutting round follows previous GATT conferences in Geneva in 1947, Annecy, France, in 1949, and Torquay, England, in 1951.

Oil Import Limits

Mobilization Director Arthur Flemming has issued a warning to major oil companies that the Federal Government will take action to restrict oil imports if they continue at their present rates during the rest of 1955.

Flemming sent a letter to the companies stating that their current import policies will not assure domestic oil production at levels necessary for national defense as defined by the President's Advisory Committee on Energy Resources. He said that during the first seven months of this year domestic crude oil production increased about 5 percent above 1954, while imports of crude oil were boosted nearly 15 percent and imports of residual oil by some 23 percent.

Congressional leaders were quick to support Flemming in his move to halt the excessive flow of foreign oil into the United States.

At this writing, the Office of Defense Mobilization is receiving replies from the oil companies and may make some announcement shortly of the course it expects to pursue.

Meanwhile, ODM has named Harold D. Gresham advisor to Flemming in matters relating to imports which affect the national security. Gresham, who has had long experience with the Tariff Commission, will investigate claims of industries petitioning for relief under provisions of the Trade Agreements Act. Coal and fluorspar producers have such petitions now pending before ODM.

Coal Export Program Ends

The Government program for purchasing U. S. coal for export, launched last year, has been quietly terminated by the International Cooperation Administration.

In a letter to Rep. Mollohan (Dem., W. Va.), John B. Hollister, director of ICA, said the agency had decided against any special coal program this year. He declared that coal for mutual security assistance overseas generally will be bought from "the most economical source, whether in this country or abroad."

Hollister said that the U. S. coal industry has made a "substantial recovery" through expansion of its domestic markets. Mollohan charged that this statement is incorrect and cited figures to show that in West Virginia over 700 jobs were lost in the coal industry.

Renegotiation Act Study

A study is currently being conducted by the staff of the Joint Congressional Committee on Internal Revenue to determine whether the Renegotiation Act needs to be extended beyond its scheduled termination date of December 31, 1956, and in case any extension is necessary, to come up with recommendations as to the length and scope of such extension.

This study was directed by Congress in approving the last revision of the Act. The Committee has asked that industry representatives having suggestions as to termination or continuance of the law submit their views in writing by October 31.

The Committee is seeking the following information: whether renegotiation should be terminated or continued; if continued, whether it should be limited in scope and to what areas; and how the present procedures for reporting information to the Renegotiation Board may be simplified.

Mining Law Regulations

The U. S. Forest Service and the Bureau of Land Management are laying plans for carrying out the provisions of Public Law 167 of the last session, which provides procedures for eliminating abuses of the mining laws and for clearing up the status of surface rights on old mining claims.

The Forest Service, which received a supplemental appropriation of some $300,000 just before Congress adjourned, has issued instructions aimed at establishing operating procedures in four areas in the West with an estimated 1500 claims in each. Results of these trial runs will be compiled and reviewed and the Forest Service will then adopt a standard procedure designed to clear up the status of surface rights on mining claims in the National Forests. The procedure as set forth both in the law and the Forest Service regulations requires that mining claimants on claims located prior to July 23, 1955, be afforded opportunity to establish their rights to the surface resources of their claims under the prior law. If the mining claimant does not care to come forward at such a hearing, he retains the subsurface rights and full use of so much of the surface resources needed for prospecting, mining and processing operations. The Forest Service chose the four areas because they are estimated to contain old abandoned claims, valid operating claims, and some claims with valuable timber.

Meanwhile, the Bureau of Land Management is currently drafting regulations to govern administration of its public domain lands under the new law and expects to make them public shortly.

The new law, hailed by President Eisenhower as one which would facilitate sound administration of the Nation's public lands, is designed to prevent abuses by those who stake mining claims for other than mining purposes, and to clarify title to surface resources prior to patent. After a claimant takes his property to patent he receives full fee simple title to both surface and subsurface resources as heretofore.

Barter for Strategic Materials

The Agriculture Department, through its Commodity Credit Corporation, is expected to make a determined effort at the next session of Congress to increase its negotiations with allied nations for surplus U. S. agricultural products in exchange for strategic and other storable materials.

The Commodity Credit Corporation has revealed that it will currently consider barter proposals for such materials as aluminum, antimony, asbestos, bauxite, beryl, bismuth, chromite, cobalt metal, graphite, manganese ore, mica, nickel, platinum, palladium, rare earths, selenium, and talc.

During the fiscal year 1955 the Commodity Credit Corporation entered barter contracts totaling $282 million. The Department, hiding behind a cloak of national security, has refused to furnish a breakdown of the materials received under these contracts.

DMEA Exploration Contracts

In the four years of its existence, through August 1955, the Defense Minerals Exploration Administration has approved 809 contracts with a total cost of over $38 million, of which the Government has advanced slightly over $23 million.

Actually in force at the end of August were 228 contracts, the remainder having been cancelled or terminated. Total cost of the contracts in force was placed at $20.5 million.

During the month of August (latest report on contracts let) contracts were negotiated for mineral exploration in five States and Alaska, involving about $278 thousand. These contracts covered exploration for mercury in Alaska, uranium in Colorado, Washington and Wyoming, lead and zinc in Idaho, and mica in North Carolina.

Coal Outlook

Addressing a recent meeting in New York, Assistant Secretary of Interior Felix Wormser predicted that coal production may be due for a steady increase in the next ten years.

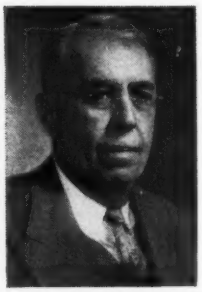
He said he doubted that these ten years would see any substantial displacement of conventional fuels by solar or nuclear energy. He also stated that the problem of oil imports might force the United States to set up restrictions.

His reasons for the steady increase in coal, Wormser said, were: (1) efficiency in the mining and use of coal is improving, (2) costs of production continue to decline, (3) experiments in pipeline transportation of coal indicate that substantial savings may be made in this field, (4) new and spectacular sales may result from production of synthetic oil from coal, (5) new uses for coal are constantly being developed, and (6) increased domestic demand is in sight for the future.

He forecast that the industry may expect gains of 25 to 30 million tons a year on the average for the next ten years.

AMC Personals

W. Lunsford Long of Warrenton, N. C., president of The Tungsten Institute, has been elected president of three companies in the strategic metals mining industry. Announcement of his election followed meetings of the Boards of Directors of Haile Mines, Inc., Tungsten Mining Corp., and Manganese, Inc.



Long, vice-president of the three companies since their organization, succeeds the late Hewitt S. West, who died September 2.

Long has served his native state as Representative for one term and as State Senator for five terms. He was president pro tem of the North Carolina State Senate for three terms, and a trustee of the University of North Carolina from 1917 through 1931.

Several reorganization changes have been made after the recent merger of Island Creek Coal Co. and Pond Creek Pocahontas Co.

Nicholas T. Camicia, former general manager for Pond Creek, has been appointed general manager of mines for Island Creek. He will be in charge of all plants and coal production.

Hubert H. Barber, former general manager for Island Creek, has been appointed assistant to the vice-president of operations for labor and public relations.

Island Creek's former chief engineer, **W. F. Diamond,** has been named assistant to vice-president of engineering.

F. C. Menck has been appointed engineering consultant to the vice-president of operations. He will have responsibility for special engineering projects assigned by the vice-president.

W. W. Reed, former director of purchases for Island Creek, has been named manager of purchases and will report directly to the vice-president.

Operating properties of the company have been grouped into three divisions under the general manager of mines.

L. G. Barber has been promoted to manager and **J. O. McNeill,** assistant manager of the Rockhouse Division. **R. M. Johnson** is manager and **M. M. Marchich,** assistant manager of the Holden Division and **D. E. Bayer,** manager, and **R. H. Tinsley,** assistant manager of the Bartley Division.

John J. Reed has joined the staff of the St. Joseph Lead Co. as head mine research engineer to develop a Department of Mining Research. Reed until recently has been with the University of California, where he was awarded a PhD in mining last June. He has also worked in South American copper mines.

C. W. Connor, Jr., has been appointed district superintendent for the Gary, W. Va., district of U. S. Steel Corp., Coal Division. Connor was assistant superintendent prior to his promotion. He joined U. S. Steel in 1942 and has served in various supervisory capacities since.

Lloyd M. Lineberry succeeds Connor as assistant superintendent. He began his U. S. Steel career in 1920 as an accountant and held the position of a district superintendent at the time of his promotion.

Frederick Laist has retired as vice-president in charge of metallurgical operations of The Anaconda Co. **Russell B. Caples,** president of Anaconda Aluminum Co. and former manager of Anaconda's Reduction Works at Great Falls, has been named to succeed him.

Caples went to Anaconda in 1910 after graduation from the Missouri School of Mines with a B.S. degree in mining engineering. He worked in the testing and research departments until 1915 when he became assistant superintendent of the electrolytic zinc plant at the Anaconda Smelters. He became manager of the Great Falls Reduction Department in 1941 and was appointed president of Anaconda Aluminum Co. in 1953 with headquarters in New York City.

William Wraith, Jr., has been appointed assistant to Caples. Wraith comes from the position of assistant general manager of the Chile Exploration Co. at Chuquicamata. Previous to that he was general superintendent of the Greene Cananea properties.

Elwood B. Nelson has been appointed general manager of the coal mining division of United States Steel Corp. He assumed the newly created post October 1. He was formerly chief engineer of raw materials of U. S. Steel's Tennessee Coal and Iron Div.

Lawrence A. Roe has been appointed minerals beneficiation engineer by the Engineering Division of International Minerals & Chemical Corp. He will be a member of the Engineering Division's Chemical Engineering group under the direction of John G. Kronseder.

Callahan Zinc-Lead Co. has increased its Board of Directors from six to nine members with the election of three new members, Joseph T. Hall, president, announced recently.

The new directors are:

Gordon Dean, who is associated with Lehman Brothers.

Joseph H. Hirshhorn, metal mining executive.

Philip D. Wilson, consulting mining engineer and geologist.

Gordon Dean

Jos. H. Hirshhorn

Philip D. Wilson

Dean, former Chairman of the United States Atomic Energy Commission, is a senior vice-president of General Dynamics Corp. and chairman of the board of Nuclear Science and Engineering Corp. He is also a Director of Fruehauf Trailer Co. and the Norden-Ketay Corp., parent company of Nuclear Science.

Hirshhorn is a Director and large stockholder of Algom Uranium Mines, Ltd. and of Fronto Uranium Mines, Ltd., which recently went into production in the Blind River area of Ontario, Canada. Hirshhorn is also a stockholder and director of other uranium companies and mining and oil ventures in Canada.

Wilson is a member of the Finance Committee and a director of the AIME, a vice-president of the Mining and Metallurgical Society of America and a member of the Society of Economic Geologists. He is now associated with Lehman Brothers.

Allan E. Jones, who for the past three years has been associated with the U. S. Atomic Energy Commission's raw materials procurement program in the Union of South Africa, has been named Deputy Manager of the Grand Junction Operations Office of the Commission at Grand Junction, Colo., it was announced recently by Manager Sheldon P. Wimpfen. Jones, who reported for duty September 7, has a background of nearly 23 years in various phases of the mining industry, including nearly 18 years with one California company.

Pittsburgh Consolidation Coal Co. has announced the following changes in its organization due to the recent death of C. E. Beachley, secretary-treasurer. **John Corcoran**, in addition to his present duties as vice-president and counsel, has also been elected secretary of the company. **James F. Bisset**, controller of the company since 1945, has been elected vice-president and treasurer. **Robert M. McCarthy**, assistant controller since 1948, has been appointed controller of the company.

Robert B. Anderson will assume the presidency of Ventures Limited, according to an announcement by **Thayer Lindsley**, founder of the company. Lindsley is scheduled to become chairman of the board. Anderson recently resigned as United States Deputy Secretary of Defense. He joined the Eisenhower administration as Secretary of the Navy in 1953 and was promoted to Deputy Secretary early in August of this year.

J. B. Haskell, manager, Market Research and Engineering Development, West Virginia Steel & Manufacturing Co., Huntington, W. Va., retired October 1 after 33 years in the coal industry. No successor is being appointed. Haskell's duties will be divided among several existing departments in the organization.

Haskell's friends and associates tendered him a testimonial dinner on September 28 at the Prichard Hotel in Huntington.

— *Obituaries* —

Charles A. Chase, 78, widely known Colorado mining engineer, died in Denver August 31 after a lengthy illness. Mr. Chase was a retired executive vice-president of the Shenandoah-Dives Mining Co. of Silverton, Colo.

After graduation from the University of Colorado in 1898 he embarked on his mining career. From 1898 to 1924 he served successively as assayer, surveyor, general superintendent, consulting engineer and manager of the Liberty Bell Gold Mining Co., Telluride, Colo. During that period he was also consulting engineer for the United States & British Columbia Mining Co.; associate general manager of the Mogul Mining Co. of Terry, S. D.; consulting engineer for the Aztec Mine of the Maxwell Land Grant Co.; manager of the Primos Exploration Co., Empire, Colo., and co-founder of the Shenandoah-Dives Mining.

For a time he served as vice chairman of the Metal Mining Fund of Colorado. He was a past chairman of the American Institute of Mining Engineers, Colorado Chapter; past president of the Colorado Scientific Society and a frequent contributor to mining journals.

William A. Kyner, president of Trabella Uranium Mines, Inc., and a director of Golden Cycle Corp., died September 12 after a heart attack.

Charles E. Beachley, secretary-treasurer of Pittsburgh Consolidation Coal Co. since its formation in 1945 and associated with one of its predecessor companies since 1916, died August 28 in West Penn Hospital, Pittsburgh, Pa.

Frank Hall Armstrong, 77, died in Gardena, Calif., on September 2 of a heart attack.

Mr. Armstrong was first employed by the Cleveland Cliffs Iron Co. in Ishpeming, Mich. He was chief engineer for the Penn Iron Mining Co. at Vulcan, Mich., for many years during which time he built a power plant on the Sturgeon River to supply these mines with electric power (the first mines on the Menominee Range to be so electrified). In later years he was associated with the Cardox Corp.

Michaelangelo DePietro, 64, division superintendent for Island Creek Coal Co. at Holden, W. Va., died August 3.

Mr. DePietro was born in Italy in 1890. He came to the United States with his father when he was 13 years old. When his father returned to Europe a few years later, Mr. DePietro remained behind to work for Island Creek. He later studied engineering at Marshall College and returned to Island Creek, working up to an executive post with the company.

Norman P. Goodrich, 70, retired mining engineer, died on August 4, in Bismarck, N. D. He was graduated from the University of Minnesota as a mining engineer in 1910 and worked in California, Nevada, and Colorado. At the time of his retirement in 1950 he was general manager of the Bald Mountain Mining Co., Trojan, S. D.

HEWITT S. WEST

AN APPRECIATION

BY W. LUNSFORD LONG

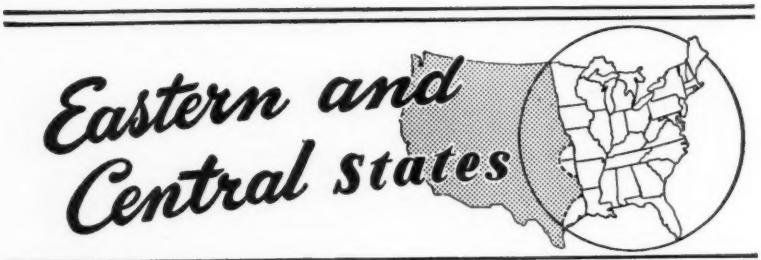
Hewitt S. West, 65, president of Haile Mines, Inc., since 1936, died at Memorial Hospital in New York, on September 2. He had been active in mining for the past 30 years, and under his leadership Tungsten Mining Corp. and Manganese, Inc., controlled by Haile Mines, Inc., had become two of the largest producers of the metals in the United States. West was also chairman of the board of the Coconino Pulp and Paper Co. of Flagstaff, Ariz.

A spirited man, with foresight and zeal, he had exerted his efforts toward the development and future of mining. Recognized for his determination and achievements, his passing is a loss to the metals mining industry.

George T. Alley, 60, superintendent of the Green Diamond Mine, Marissa, Ill., passed away July 18. Mr. Alley, who had been superintendent for the coal mine for five years, had been in failing health for several months.

Ralph Coolidge Mulligan, 67, former Director of Public Relations of National Coal Association, died August 25 at his Washington, D. C., home. Mr. Mulligan's association with the bituminous coal industry covered a span of nearly 30 years. He retired on October 1, 1954, but had since been in a consulting capacity to NCA.

Prior to his service with the coal industry, Mr. Mulligan served the Republican National Committee in the campaigns of 1924 and 1928. In 1926 he served as publicity director for the Republican Senatorial Committee and in 1932 he was a member of the staff of Gen. William J. Donovan in his campaign for the Governorship of New York. During his service with NCA, Mr. Mulligan handled the publicity phases of that organization's activities. He was director of NCA's Priorities and Procurement Division during World War II.



Coal Sales Companies Merge

The Pocahontas Fuel Co. has announced that the sales organizations of William C. Atwater & Co., Inc. except for the Export Department, were merged into the Sales Department of Pocahontas Fuel Co. October 1. The merger follows the acquisition by Pocahontas of William C. Atwater & Co. and a substantial interest in the American Coal Co. of Allegheny County which operates the Deerfield, Piedmont and Crane Creek Mines in the Pocahontas field.

Lone Star Expands Again

Lone Star Cement Co. has announced its third major expansion program this year. The latest includes construction of a new 2,000,000 - bbl capacity plant at Lake Charles, La., and the enlargement of existing plants at Hudson, N. Y., Dallas and Houston, Tex.

Productive capacity of the company's Dallas plant, first of the Lone Star system, will be increased 50 percent, or 1,400,000 bbl, to a total of 3,700,000 bbl by the installation of two additional kilns as well as grinding equipment and other auxiliary structures.

The enlargement program in Houston will increase the annual capacity of that plant by over 50 percent, or 1,100,000 to a total of 3,200,000 bbl. A third kiln will be installed, together with additional raw and finish mills, clay handling and storage equipment.

The Hudson expansion calls for the addition of a fifth kiln together with a new crushing plant, raw and finish grinding mills, dust collectors, coal handling system, raw storage and power plant extension and other related installations and structures. Here capacity will be increased 1,000,000 bbl to 3,000,000 bbl annually.

Expansion Program

Directors of Republic Steel Corp. have approved an expansion program that will cost more than $130,000,000. They intend to add 1,618,000 tons of steel ingot capacity to their present capacity of 10,261,000 tons per year. The new capacity will be added to Republic's basic steel plants in Cleveland, Warren and Youngstown, Ohio; Chicago; and Gadsden, Ala. That will be accomplished mostly by increasing the size of present production facilities.

EG&FA to Open Mine

Preliminary work has been started for the opening of a new coal mine in Raleigh County, W. Va., by Eastern Gas & Fuel Associates. The operation, to be known as Stotesbury No. 10 mine, will be located at Helen, W. Va., a short distance from the Helen No. 9 mine that was closed late in 1953.

The new mine is expected to produce 1000 to 1500 tpd it is reported. Full production is not expected until early in 1956.

Coal produced from the Pocahontas No. 4 seam in the new mine will be loaded over the presently idle mine preparation plant.

Reynolds Expands

The Reynolds Metals Co., with main offices at Richmond, Va., have recently announced a $230,000,000 expansion program. The largest single expenditure will be for a reduction plant in the Ohio River Valley. A unique feature of the plant will be a 300,000 kw power station, using coal for adjacent company-owned deposits.

Annual Conference of the Coal Division

William Penn Hotel, Pittsburgh, Pa., Friday, November 18, 1955

THE 1955 Conference of the Coal Division of the American Mining Congress will be held at the William Penn Hotel in Pittsburgh on Friday, November 18. This will be a one-day meeting—a morning session convening at 9:30 a. m., a business luncheon and an afternoon session adjourning about 4:30 p. m.

All coal operators and equipment manufacturers are cordially invited to attend—to hear the subcommittee presentations and to take part in the open floor discussion. The reports which will be presented by the committees, as listed below, are the results of studies that have been carried on during the past year. The subjects cover the major operations of mining and the accounts will describe successful practices with new and improved types of mining equipment.

All reports are based on actual underground operations and are presented by men who are fully experienced in their special subjects. Copies of each subcommittee report will be distributed to the audience so that all may have the opportunity to offer their comment or suggestions. Such comment will subsequently be carefully reviewed by each subcommittee.

Committee on Coal Preparation—R. L. Llewellyn, Chairman, Delays in Cleaning Plant Operation—Cleaning Plant Maintenance—Washery Water Clarification—Preparation Problems of Continuous Mining.

Committee on Conveyor Haulage—H. A. Jones, Chairman, Mechanical Loading Onto Bridge and Chain Conveyors—Safety Controls for Belt Conveyors—Main Line and Intermediate Mine Haulage.

Committee on Mechanical Mining — Wm. E. Hess, Chairman, Maintenance of Continuous Machines—Gathering Haulage for Mechanical Loading—Industrial Engineering—Dust Control in Continuous Mining.

Committee on Rail Haulage—J. D. Reilly, Chairman, Mechanical Loading Direct into Mine Cars—Main Line and Intermediate Mine Haulage—Construction and Maintenance of Mine Haulage Roads.

Committee on Roof Action — C. O. Kane, Chairman, Rotary Drilling for Roof Bolts—Geological Study on Mine Roof—Torque Requirements for Roof Bolts—Suggested Recommendations for Roof Bolting.

Committee on Underground Power — J. A. Dunn, Chairman, Trailing Cables Underground—Temporary Splices for Cables—Permissibility Problems—Coal Mine Lighting.

P&R Changes Name

At a special meeting held August 15, shareholders of the Philadelphia and Reading Coal & Iron Co. approved broadened charter powers and the change of the company name to Philadelphia and Reading Corp. P&R had earlier announced this year that it intended to diversify its activities.

Methane Emission Study

Additional precautions against methane in coal mines should be taken when the barometer is falling, the Bureau of Mines has announced in a recent report. The Bureau's warning is based on a study at an Illinois coal mine which proved that when barometric pressure dropped, gas fed into adjacent airways both from sealed and unsealed abandoned workings.

Special instruments were employed in the Bureau's research, the first of its kind in a commercial coal mine in the United States. The Chicago, Wilmington & Franklin Coal Co. made its Orient No. 2 Mine at West Frankfort, Ill., available for the study, and the Mine Safety Appliances Co. assisted in modifying the instruments. Methane content of the air at two underground stations and at the main exhaust fan was recorded as completely as possible over a period of several weeks. Recorded readings were spot-checked during times of extreme pressure change.

Bureau researchers found that the methane content of the air exhausted from the mine ranged from about 0.5 percent during barometric highs to as much as 1.5 percent during extreme lows.

A copy of R. I. 5147, "Effect of Changes of Atmospheric Pressure on Gas Emissions from Worked-Out Areas in an Illinois Coal Mine," by D. D. Dornenburg, J. A. O'Connor, and E. J. Harris, can be obtained from the Bureau of Mines, Publications-Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa. It should be identified by number and title.

Cerro de Pasco Move

Principal office of Cerro de Pasco Corp. has been moved from 40 Wall St. to 300 Park Ave., New York 22, N. Y. The company is now occupying office space in a newly constructed building.

Option Sandstone Deposit

According to Gerald Gidwitz, chairman of the board of Continental Uranium, the company has acquired an option to purchase the Marion Silica Co., Marion, Ky.

Continental has undertaken engineering and market studies to determine whether to exercise its option on the estimated 30,000,000-ton Hardinsburg sandstone deposit.

Mines Change Hands

Maryland Coal & Coke Co., a coal sales firm with headquarters in Philadelphia, recently purchased properties of four coal companies in Fayette County, W. Va. The company's purchase were: the Branch Fuel Co. at Greenwood; Laurel Smokeless Coal Co. at Laurel Creek; Fire Creek Fuel Co. at Beelick Knob, and Alaska Coal Co. with a mine at Beelick Knob and another at Bellwood. The five mines involved in the transaction currently produce about 20,000 tons of coal a month, it was reported. Spokesmen for Maryland said it was hoped to double that output after the operations were completely mechanized.

Push Montcoal No. 7

Armco Steel Corp is pushing construction for the rapid completion of its new Montcoal No. 7 mine at Montcoal, W. Va. The new mine is being opened in the No. 2 Gas seam and is expected to produce 90,000 tons a month when in full production, early in 1956.

Armco is at present producing coal from the Dorothy seam in its Montcoal No. 1 mine.

The new drift mine will be located about 600 ft above the present preparation plant on the banks of Coal River. Two 750-ton storage bins near the cleaning plant will be constructed. These bins are to be filled by a rope and button conveyor that will lower the coal from the mine down the side of the mountain. Mine officials say, according to a report, that a haulageway will be driven about 4000 ft through the mountain. It will emerge on Big Ranch Creek where the company plans to construct its main shop and other service facilities.

Coal for Utility Co.

A national coal company has contracted to deliver coal by barge from its Uniontown, Ky., docks to a large electric utility plant in Tampa, Fla. The Tampa Electric Co. is undertaking an unprecedented move in the use of coal in utility plants in the Gulf area. TECO one of Florida's largest utilities, has been using oil in its power plants since 1917.

The coal firm will use six barges, each with a capacity of 3500 tons of coal, to transport approximately 12,000 tons a week at Black Point plant which is scheduled to begin operation in the Spring of 1957.

Company officials report that TECO was prompted to investigate the possibility of using coal after the increase in the cost of oil endangered stable power rates in the area. Though there will be no appreciable difference in the rates at first, the utility expects the use of coal will guard against cost increases in the future.

Pigments Plant

Canadian Titanium Pigments, Ltd., a subsidiary of National Lead Co. will build a $15,000,000 titanium oxide plant about 15 miles from Montreal. This is the first such plant in the Dominion and will be designed to meet Canada's entire requirements.

Close Stanaford No. 1

The Stanaford No. 1 mine of the New River Co., whose old workings stretch under some parts of Beckley, W. Va., produced its last ton of coal August 12 after being in active production for more than 55 years.

Stanaford No. 1 was opened in 1901 by the Piney Colleries Co. on the mountains above the New River Gorge. In 1917 the property was purchased by Piney Coal Mining Co. and was acquired in 1926 by the Koppers Coal Co. Koppers operated the plant under the name of Elkhorn Piney Coal Mining Co. until February 1937 when the name was changed to the Koppers Coal Co. In 1949 the name was changed and the company operated as Koppers Coal Division of Eastern Gas & Fuel Associates.

The New River Co. purchased the property from Eastern Gas in 1945. After the purchase, New River divided the property in half and operated it as two mines, the Stanaford No. 1 and Stanaford No. 2. Work was started pulling the pillars back to make the No. 1 mine and separate it from the No. 2 underground workings. No. 2 mine began operation late in 1948.

July Coal Use All-Time High

The Federal Power Commission has reported that consumption of coal by electric utility plants reached an all-time July record 11,718,016 tons. This represents an increase of 24.5 percent over consumption figures for July 1954 and a 5.9 percent increase for total of June of this year.

For the year ending July 31, the total consumption of coal in the electric utility industry was 130,798,731 tons of coal. This amount represents an increase of 12.2 percent for coal over consumption for the 12 months ending July 31, 1954. During the same period, consumption of gas in the electric utility industry increased 4.7 percent, but a decrease of 0.8 percent was shown for oil.

Manganese Pilot Plant

The Government has made a contract with Ores Beneficiation, Inc. of Joplin, Mo., to erect and operate a pilot plant for testing purposes over the next 15 months. The General Services Administration said the plant is to handle 300 lbs per hr of slags and low-grade manganese ores by a new process developed by the Bruce Williams Laboratories in Joplin. Ores Beneficiation is to turn over to the Government all technical test data as well as plans for the later building of a 500-tpd plant if the process is successful.

Coal Operation Near Hinton

Watts Fuel Co. announced it has leased several hundred acres of coal property for mining purposes near Hinton, W. Va. Work on the tipple is being started immediately and the Chesapeake & Ohio Railway will construct a 10-car side track to serve it. Officials of the company are hopeful that the mine will be in operation by mid-November. The property under lease is chiefly in Summers County—which has never before produced coal in quantity.

To Reclaim Mica

International Minerals & Chemical Corp. has begun construction on a mica plant at Greeneville, Tenn., Louis Ware, president, has announced.

The plant will reclaim mica from silt that has accumulated behind the Davy Crockett Dam in Nolichucky Reservoir near Greeneville. The product will find a market in roofing, paint and rubber.

Expected to be in production in the spring of 1956, the plant will cost about $400,000. It will be operated by the Industrial Minerals Division of International Minerals & Chemical Corp., which already operates 20 plants for various minerals in the United States and Canada.

Initial capacity will be approximately 100 tpd. The mica is expected to be of particularly high quality for certain uses because it has been delaminated by transportation and prolonged immersion. Reserves of raw material are large.

Commercial value of the mica reserve was developed by the TVA through its program to assist in the utilization of all the minerals in the TVA area. International was the successful bidder on a lease from the TVA for reclamation of the mica reserve.

New methods of extraction and purification had to be developed for the mica from this unusual source.

Buy Coal Mine

Clinchfield Coal Co. of Dante, Va., has purchased the Ten Mile mine of the Haywood Coal Co. The mine, currently producing about 1000 tpd, is located in Dola in Harrison County, W. Va.

Clinchfield officials say the mine will be operated by the Compass Coal Co. of Clarksburg, a subsidiary of Clinchfield. Compass operates three other mines in the vicinity.

The mine reportedly will continue present production until a new cleaning plant can be constructed. Completion of the cleaning plant is expected some time next year. When it is finished, production of the mine will be increased to 5000 tpd.

Convert Lake Freighter

The 420-ft bulk freighter *Presque Isle*, one of the Cleveland-Cliffs fleet veterans which was sold last January to the Huron Portland Cement Co., Detroit, was sent to Sturgeon Bay, Wis., where she will be converted into a cement carrier at the Christy Corp. shipyard. Huron Portland Cement Co. officials said the ship, when completed, will be modern in every respect as a cement carrier, using an air-slide self-unloading system. Addition of the *Presque Isle* brings the fleet of the Huron Portland Cement Co. to a total of five carriers.

C & H Transfers Timber Land

Calumet & Hecla, Inc. has transferred approximately 230,000 acres of timber lands and non-mining properties of its Calumet Division to the newly created Forest Industries Division.

The transfer, announced by Endicott R. Lovell, president, includes tracts of land in Keweenaw, Houghton, Ontonagon and Marquette Counties of Michigan and represents some of the most valuable assets of the company, Lovell stated. Specifically excluded from the transfer are the actual mining properties, which remain with the Calumet Division.

Lease Coal Lands

The Watts Fuel Co. has announced that it recently leased several hundred acres of coal lands near Hinton, W. Va. for mining purposes. Two seams of coal, the Beckley and the Fire Creek, are available. Company officials were hopeful that a new mine on the property would be in operation in November.

Present plans include the construction of a tipple and a 10-car side track to the tipple.

Geophysicists Meet

Latest developments in the world-wide hunt for oil and uranium were reported at the 25th annual convention of the Society of Exploration Geophysicists in Denver October 2 through 7.

Nearly 1500 men engaged in this work throughout the Western Hemisphere traded information on new equipment and techniques in putting science to work in this strategic search.

G. M. Knebel of New York City presented latest information on known oil reserves throughout the world. Sigmund Hammer of Pittsburgh reviewed geophysical activity this year. Milton Dobrin and Robert G. Nostrand, both of Dallas, reported on a survey of new trends in geophysical exploration.

They were among the 80 leaders in the field who discussed 56 topics during technical sessions October 3, 4, 5 and 6. The convention closed with a field trip to study geology of the Front Range of the Rockies west of Denver October 7.

During the convention, Paul L. Lyons of Tulsa was succeeded as president of the Society by Robert C. Dunlap, Jr., of Dallas. Other highlights included presentation of honorary awards, a luncheon honoring charter members and past presidents, and a dance.

Eastern Ohio Coal Mine

Lorain Coal & Dock Co., with main offices in Columbus, Ohio, has started work in eastern Ohio on a new coal mine. Preliminary excavation at the mine portal, located at Wolfhurst, Ohio, has already been completed and it was expected that coal production would begin in early October.

The new mine was started to supplement the diminishing coal supply at the nearby Blaine and Stanley mines of the company.

West Kentucky Expands

The West Kentucky Coal Co., with offices at Madisonville, Ky., has acquired the mining, selling and transportation property of the Nashville Coal Co. through purchase of all of Nashville's stock by wholly-owned subsidiary of West Kentucky, Nashville Coal Inc.

The Nashville Coal properties involved in the deal include five operating coal mines in the Western Kentucky field with about a 5,000,000-ton annual capacity. A long-term lease has also been concluded with Nashville Coal for 85,000 acres of coal land with an estimated 700,000,000 tons of recoverable coal. The newly affiliated companies' total sales volume is listed at about 12,500,000 tons, with estimated combined reserves of more than one billion tons of recoverable coal.

Mining properties acquired include the Miners Coal Co., Williams Coal Co., Stonypoint Coal Co., Crescent Coal Co., and Uniontown Coal Co.

West Kentucky Coal, and its predecessor, the St. Bernard Coal Co., have continuously operated since 1870 in the West Kentucky field. They have produced and sold more than 150,000,000 tons of coal.

BOOK REVIEWS

FROM MINE TO MARKET. *By Joseph T. Lambie. New York University Press. 380 pp. Illustrated. $6.*

IN February 1881, at an auction in Richmond, Va., some Philadelphia capitalists bought up an insolvent railroad company that operated a line from Norfolk, Va., to Bristol, Tenn. They reorganized it as the Norfolk & Western Railroad Co. On March 17, 1883, with a display of flags and a battery salute from the Light Artillery Blues, the first carload of Pocahontas coal rolled into Norfolk, Va., over that railroad.

Since 1883 much has happened to the N & W. It penetrated to and beyond the Ohio River and tapped one coal field after another. It went into a receivership and merged as Railway instead of Railroad. It became an important factor in Lake cargo traffic and at one time came under financial domination of the Pennsylvania Railroad. Its major importance, however, has always rested in its role as a great regional coal carrier.

This book is a must for all those interested in the coal mining industry and its colorful history. To the operating man it will bring an insight into a phase of the industry not often explained with so much understanding. Although it is primarily a history of a railroad, coal is so closely tied to the N & W that the book also becomes a history of early coal production in Southern West Virginia.

Spar-Mica Development

Arrangements have been completed by Spar-Mica Corp., Ltd., for extensive development of its properties. A load-dock at Johann Beetz, Quebec, on the St. Lawrence River, will be completed as part of the project. One of the company's two large feldspar deposits is located here.

Other expansion plans include the installation of new mining equipment and mill facilities and the construction of a transfer mill at Camden, N. J. Finished feldspar will be shipped by boat in 10,000-ton lots from the Canadian property to Camden, where it will be stockpiled and transferred to customers.

Spar-Mica is jointly controlled by Strategic Materials Corp. and Electro Refractories & Abrasives Corp., both of Buffalo, N. Y.

Armco Safety Day

Outstanding accident prevention records of mines and individuals were recognized as Armco Steel Corp. coal mines held their 25th Annual Safety Day and First Aid Meet at Montcoal, W. Va., August 27.

Forty-two awards from the Joseph A. Holmes Safety Association were presented during the program, as well as two awards from the West Virginia State Department of Mines. The Armco mines at Nellis and Montcoal had no fatalities from April 9 to February 28, 1955, a total of 3,702,675 man-hours while producing 3,880,548 tons of coal.

The day's activities were climaxed by a mammoth fireworks display.

Rare Earths Development

W. R. Grace & Co. has announced that its Davison Chemical Co. division and Rare Earths, Inc., a wholly-owned subsidiary, have joined in a program of expanded production, sales, research and development of rare earths and thorium.

To coordinate Grace's interest in the field of industrial atomic energy, Davison has formed an Atomic Developments Department with headquarters at Baltimore, Md. Dr. Allen T. Cole, formerly manager of the company's Florida phosphate division, has been made manager. One of the objects of the new department will be to expand industrial uses of rare earths through research, a continuation of work done in this field by Rare Earths, Inc.

The new activity fits into Davison's long established interests, since monazite sands are about equal to phosphate rock in phosphorus content. In processing them to obtain thorium and rare earths, sulphuric acid is used and recovered, and phosphoric acid is derived as a by-product. Both are presently manufactured by Davison.

Titanium Plant Cancelled

Office of Defense Mobilization has announced cancellation of a Government-financed titanium metal plant at New Johnsonville, Tenn. Tax write-offs and government purchases have been suspended because current titanium metal production is considered ahead of the indicated rate of the military utilization of the metal.

Harold S. Vance, special consultant to ODM, predicted the light, heat-resistant metal eventually will become a valuable and strategic material for military usage, particularly in aircraft, air-borne equipment and high-altitude, long-range missiles. However, he said that before this happens the cost will have to be reduced, fabrication processes improved, and uniformity of quality assured.

ODM noted that melting and fabrication problems appeared to have temporarily delayed wider use of the metal. Both industry and Government researchers are working on these problems.

Letter to the Editor

Dear John:

Your editorial, "C'mon In," in the August issue of MINING CONGRESS JOURNAL hit the bull's eye and should contribute to greater representation of the metal and nonmetallic mineral mining industries at the National First-Aid and Mine-Rescue Contest at Knoxville this fall. That is a development for which I have been hoping ever since the national contests were revived after World War II. It has disturbed me to have anyone feel that these contests were exclusively for the coal-mining industry, since the Bureau of Mines is dedicated to promoting safety in all branches of the mineral industries, including not only metal and industrial mineral mining and treatment, but also quarrying, petroleum and natural gas production and transportation, and oil refining.

My experience during my 40 years with the Bureau of Mines has convinced me increasingly that first-aid training is one of the most effective means of preventing accidents, because it makes men safety conscious as well as preparing them to deal with accidental injuries. The contests that the Bureau has assisted and encouraged since its formation in 1910 on local, county, district, State and national scales unquestionably stimulate interest in such training, and I am indeed glad that metal mining companies will be represented at Knoxville. Mine-rescue training, the value of which I have seen illustrated after dozens of disasters, is needed as much in many other types of mines as at coal operations. Indeed, some of the best mine-rescue organizations in the country are maintained in ore-mining districts, and I am glad to see that some of them will compete this fall.

In thanking you for and congratulating you upon your August editorial, I wish also to let you know how much I appreciate the sincere interest in safety as well as efficiency that you have displayed for many years and the realization you have consistently displayed that actually the two are inseparable.

Sincerely yours,

JOHN J. FORBES,
Director, U. S. Bureau of Mines, Department of the Interior.

Pandora Mill

(Continued from page 34)

Ore Is Complex

Metallurgically, the ore can be classed as complex. The sulphides as a whole are readily liberated from the gangue and each other at a normal 65-mesh grind (60 percent minus 200 mesh). The pyrite and sphalerite are highly activated when the ore reaches the mill. An accurate balance and close control of reagents is essential. Best results are obtained when scavenger concentrates plus cleaner tailings are returned to the head of the grinding circuit for attrition scrubbing, contact with fresh reagents and and further conditioning. Economics of the Pandora operation are based on the above mill results.

	Assay Percent			Distribution Percent		
Product	Pb	Cu	Zn	Pb	Cu	Zn
Heads	2.0	1.0	4.0	100.0	100.0	100.0
Lead Concentrates	66.0	3.5	3.0	93.1	9.8	2.1
Copper Concentrates	1.5	26.5	5.0	2.2	78.9	3.7
Zinc Concentrates	0.4	1.0	58.5	1.2	6.0	87.6
Tails	0.08	0.06	0.30	3.5	5.3	6.6

Summary

For the Telluride operation to be profitable, it was necessary to expand mine production and mill capacity to 30,000 tons per month and also modernize the entire operation to assure low costs. Modernization of the mill doubles former capacity and cuts labor force almost in half. A five-day work week offered the following advantages:

(1) Lower labor costs through elimination of relief shifts and overtime pay.
(2) Better maintenance because of ample repair time.
(3) Closer supervision due to shorter work week.

Total cost of modernization for 1000 tpd mill capacity was estimated to be $765 per ton day. For an additional cost of eight percent, capacity was increased 40 percent. This additional capacity, or the difference between 1000 and 1400 tpd, cost approximately $150 per ton day.

Acknowledgment

My sincere appreciation is extended to John S. Wise, General Manager, Idarado Mining Co., and members of his staff for their cooperation and valuable assistance in the preparation of this manuscript.

Silicone Insulation

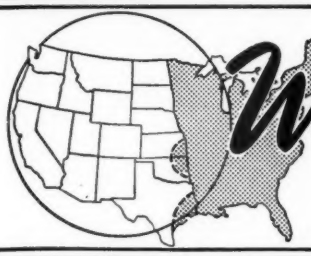
(Continued from page 55)

roughness on the commutator face. The roughness, combined with the high current density at the spots, causes the brushes to wear as if sand had been put on the surface of the commutator.

Manufacturers of the basic silicone materials, the leading manufacturers of motors, the leading manufacturers of brushes, and the U. S. Navy have conducted much research on the brush wear problem. As a result, one manufacturer is now advertising a brush which is a partial answer to the problem, and is a definite improvement over conventional brushes. It is, however, too early in the development to recommend that non-ventilated motors be designed to use silicone insulation, especially motors which must commutate high peak loads. Brush wear is still a problem, but may not be when the motor is operated at Class B temperatures. However, no broad or general statements should be made because the design of the motor apparently influences operating results.

Several schemes have been devised for avoiding brush wear by covering silicone insulation with other type varnishes to seal off the silicone. This generally takes the form of coils of silicone bonded glass-covered wire with the remainder of the insulation Class B. Its use is based on the theory that the silicone is placed at the highest temperature point in the motor. The value of this practice is questionable, because the temperature differences are slight in the windings of a well-designed, totally-enclosed motor.

A manufacturer can produce silicone-insulated, ventilated motors that embody the advantages offered by this new material. To do this, however, he must know how to apply the silicone properly and have the equipment to do so. He must also appreciate the changes in the design of component parts of the motor required by the new operating characteristics. Research and development are bringing closer the day that non-ventilated motors can be produced on the same basis.



Western States

Expand Iron Ore Facilities

Kaiser Steel Corp. has announced a large expansion program for its iron ore mining facilities at Eagle Mountain, Calif. The new works will supplement a beneficiation plant that went into operation last year and will be used to upgrade the quality of iron ore being mined in the area.

The Eagle Mountain mine, situated in Southern California, supplies iron ore for the only three blast furnaces on the Pacific Coast, at the Kaiser Steel mill, Fontana, Calif.

Hanover Reopened

The New Jersey Zinc Co. has announced that as a result of improved conditions in the zinc industry, the company will reopen its Hanover Mine at Hanover, N. M. The mine has been maintained in standby condition during the past two years. During this period, however, company engineers have worked on a program of modernization. A new head-frame was erected this spring and work is currently in progress on the sinking of a new shaft. Additional improvements will include a building to house the hoist room, mine offices and change house. A second structure will serve

Gilsonite Plant

A site near Fruita, in the vicinity of Grand Junction, Colo., has been announced by the American Gilsonite Co. of Salt Lake City as the location of its proposed processing plant for the production of high octane gasoline and coke.

E. F. Goodner, president of the American Gilsonite Co., stated that almost 1000 acres of land had been acquired for the new plant facilities and that plans and specifications are now in the hands of contractors for the preparation of bids.

The company earlier had announced its plans for laying a buried 80-mile pipeline from the proposed plant to its mine at Bonanza, Utah, where the unique hydrocarbon mineral, Gilsonite, is mined. It will serve as the raw material for producing the coke and gasoline. The revolutionary process for the production of these two commodities was devised following a million dollar research program for the past several years. More than $10,000,000 will be expended on the total project. Completion is scheduled in approximately 18 months.

American Gilsonite Co. is jointly owned by Barber Oil Corp. and Standard Oil Co. (California).

Fluorspar Discovery

Squaw Creek Mining Co. has announced the discovery of a deposit of fluorspar along the Salmon River, 170 miles from Missoula, Mont. Robert Bandy, president, states that geologists consider it possibly one of the biggest deposits in the United States.

Diversify Holdings

Shoni Uranium Co., of Riverton, Wyo., has acquired leases on 10 mercury claims in Paradise Valley in Humboldt County, Nev.

Verne R. Hughes, president of the firm, reported that exploratory work on the claims, known as the Red Crystal group, has opened a deposit of ore 150 ft wide. It apparently extends 2000 to 3000 ft in length. Grab samples indicated a good grade of ore.

Hughes said that production will begin shortly, after a small amount of overburden is removed.

To Reopen Zinc Mine

An increase in the price of zinc and the opening up of the market for zinc concentrates in the United States were determining factors in the recently announced decision to reopen the Reeves McDonald Mines, Ltd. operations near Nelway, B. C.

Before the shutdown two years ago, Reeves McDonald was milling the largest tonnage of lead zinc ore of any mine in British Columbia, except the Sullivan at Kimberley. The concentrator was completed in 1949 with a capacity of 1000 tpd and at that time about 165 men were employed.

Uranium Directory

Uranium Magazine, a monthly journal published in Denver has put out a new semi-annual directory issue. It lists some 1816 uranium companies and is believed to be the first assemblage of its kind. It is obtainable from the publisher at 601 Ogden St., Denver, at a cost of 50 cents.

Veteran Copper Pit Ready

Nevada Mines Division of Kennecott Copper Corp. is expanding open-pit operations at White Pine County, Nev. This will be done in the new Veteran Pit near Kimberly, Nev. The new Veteran Pit is located about two miles west of Kennecott's Liberty Pit at Ruth. At present 168,000 tons of ore are ready for immediate mining. Remainder of the 20,000,000-ton orebody will be mined as stripping of overburden proceeds.

Kennecott will develop and mine the Veteran Pit with Consolidated Coppermines Corp. participating to the extent of 20 percent. Consolidated claims are primarily located on the southeast edge of the new pit.

Isbell Construction Co. prepared the Veteran Pit for operations by removing 16,716,512 tons of overburden. Future operations will be conducted by Nevada Mines Division personnel.

The company plans to use 12 diesel trucks, three power shovels, heavy earth-moving equipment, a rotary drill, two churn drills, a motor grader, sprinkler truck, and fuel and lubrication vehicles in the development of the new pit. Moving the ore to the McGill Reduction Center will require construction of 2½ miles of railroad line from the new pit to main haulage track.

Kennecott reported that "parlaying of what appeared to be a 4,000,000-ton copper resource in 1923 to a minable 20,000,000 tons today is the direct result of intensive study of drill hole assays and the economies made possible through use of modern earth-moving machinery."

Big Mercury Kiln

A rotary kiln, 90 ft long and 5½ ft in diameter, is now operating at the kiln of the Rare Metals Corp. of America at the Idaho-Almaden cinnabar mine, 18 miles east of Weiser, Idaho on a 24-hr schedule.

James Snider, superintendent of the kiln, claims it is the world's largest rotary mercury kiln, and a crew of 14 men is employed at the mill site to process 200 tpd of ore. The Utah firm recently reopened the open pit mine, after it had been shut down since 1942.

Grand Old Mine Passes

Directors of Shenandoah-Dives Mining Co. have recommended to stockholders that the company be liquidated and bids be received for the assets which include a mine, mill and equipment at Silverton, Colo.

Efforts to interest other companies in taking over Shenandoah-Dives operations on a royalty basis have been fruitless.

Any offer received will be submitted to stockholders and two-thirds of the stock must approve the sale.

Howe Sound to Build Center

A research and experimental center near Salt Lake Municipal Airport will be built by the Howe Sound Co., according to H. A. Pearse, vice-president of the company.

Dr. W. M. Fassell, former associate professor of metallurgy at University of Utah will be director of research at the new center. Energies of the center will be devoted to the solution of metallurgical problems of the Calera Mining Company's cobalt refinery near Garfield, Utah, as well as all beneficiation problems of the company elsewhere in the West. Completion and occupancy are slated for January 1, 1956.

Open Pit Gold Mine

Preparations are under way to groom the Royal and Mountain King Mines on the Mother Lode West Belt for a large shovel operation. The first move by Stewart and Nuss of Fresno, Calif., will be the dismantling and sale of the Royal Mill, seven miles north of Copperopolis in Calaveras County. The two mines are on the same contiguous mineralized zone. In the early days both were good producers. High costs and limited gold price prohibit reopening of the mine by underground methods. The alternative is mass mining by open pit methods with hope of producing from 5000 to 10,000 tpd.

Stewart and Nuss officials said there is, at the two mines, a potential of 50,000,000 to 70,000,000 tons of shovel ore, made possible by favorable geological and physical characteristics, such as long and wide fractured and mineralized rock area and good topography for bench shoveling.

Kennecott Gets Columbium

Charles R. Cox, president of Kennecott Copper Corp., and Anthony M. Coskinas, managing director of Tin and Associated Minerals, Ltd., of Nigeria, announced that Kennecott has obtained a 52 percent interest in the Nigerian company. The West African Co. owns a columbium mine and concentrating plant in the highlands of Nigeria. The property has been producing approximately 600,000 lb of columbite annually.

Columbium is resistant to high temperatures and corrosion, and has significant applications in the aircraft industry and in production of steels, particularly stainless.

Monazite in New Mexico

According to an announcement by an official of Onego Corp. of Uniontown, Pa., a large find of rare-earth bearing sands has been discovered in San Miguel County, N. Mex. The 332 acres of placer and lode claims known as the "Lost Creek" group are said to contain 4,000,000 tons of sands which contain monazite, gallium, cerium, lanthanum, titanium, ytterium, yterbium and magnesium. No plans have been announced yet for the exploitation of the deposit. Monazite sand has been mined for years in the United States but, so far, only in North and South Carolina and in Florida.

Utah Safety Meet

A seven-member first aid team from Kennecott Copper Corporation's Bingham Canyon mine won first place honors September 19 in the state championship first aid contest held during Safety Day at the Utah State Fair.

The team, headed by Ross S. Pino, was presented with the annual rotating trophy given by the Utah Mining Association and a special cup presented this year by the Utah State Fair Board. They won over nine other teams from five local industries.

Winning team members included: Pino, safety engineer, of Copperton; William Garrity, safety fieldman, Copperton; Floyd H. Cox, industrial engineering draftsman, Copperton; Joe Susaeta, safety fieldman, Bingham; Norman J. Stalliviera, machineman, Midvale; Johnny E. Jarrells, trackman, Bingham, and George E. Leyba, first helper, powder department, Copperfield.

Also honored by the victory was Bill Robinson, safety inspector, of Murray, team coach. The same team won third place in last year's contest.

Other teams in the contest were entered by American Smelting and Refining Co., Kaiser Steel Corp., U. S. Smelting Co., the Geneva plant and Carbon County coal mines of the U. S. Steel Corp.

Forms Australian Unit

National Lead Co. announced the formation of a new Australian subsidiary, Mineral Deposits, Ltd. The new corporation has acquired the mine, plant and mineral leases of Mineral Deposits Syndicate. It will be owned 80 percent by National Lead and 20 percent by the former Australian owners.

Drill in North Dakota

Three drilling crews are working in the area of Beach and Sentinel Butte, N. D., seeking uranium. One crew is working on Sentinel Butte. The Wallace Beaudoin outfit moved in from Dickinson and has been drilling on the Waterland property near Carlyle. The Burmac Exploration Corp. of Williston has been working on a leased property following a three-weeks' survey by geologists to prepare the area for core drilling.

Will Build Aluminum Plant

According to a recent newspaper report Anaconda Aluminum Co. is planning to build a plant for the production of alumina from domestic clays near Spokane, Wash.

A pilot plant will be built first, probably at one of the Anaconda research stations, to test commercial feasibility of the clay reduction process.

To Build Cement Plant

The Permanente Cement Co. has recently announced its intention to construct a $12,000,000 cement plant near Southwestern San Bernardino County, Calif. The initial capacity of the plant will be 2,000,000 bbl annually with provisions to increase the capacity should the demand for cement continue to rise. Construction will begin shortly and completion is expected by the Fall of 1956.

Seek U-Mill Approval

Continental Uranium, Inc., is negotiating with the Atomic Energy Commission for a contract under which the company would construct a 200-tpd uranium ore processing mill near LaSal, Utah, Gerald Gidwitz, Continental chairman, said September 19 in a letter to shareholders.

If the ore mill contract is approved, Continental would become the first company licensed to use the Burwell process of treating uranium ores developed by Blair Burwell, uranium mining pioneer and consultant to Continental.

Continental has acquired an option for a 40-acre site for the mill with water rights. The LaSal site is located near Continental's Rattlesnake Mine and 18 miles from the Continental No. 1 Mine.

Sell Autunite Crystals

Daybreak Uranium, Inc., has started to sell specimens of almost pure autunite crystals from its mines to collectors.

According to Kae Sowers, secretary-treasurer of the company, a good market exists for masses of the yellowish green crystals. He said the company expects to average about $100 a lb for the specimens, compared to the $8.00 a lb received from the AEC for smaller pieces of ore shipped to a uranium processing plant near Salt Lake City.

Largest sample found so far has been an 82-lb mass, which is estimated by the Daybreak geologists to contain about 55 percent uranium oxide. Best specimens found so far have come from an open pit operation near Mt. Spokane, Wash.

Seek Indian Uranium

According to a recent announcement Square Deal Mining & Milling Co. of Wallace, Idaho, is exploring for uranium on the Spokane Indian Reservation in Southwestern Stevens County, Wash. Under an agreement with tribal owners of prospecting permits, the company has started a core drilling program in section 13 adjoining the producing Midnite uranium mine on the south.

Uranium mineralization was found by surface bulldozing. The drilling program is designed to determine whether the uranium mineralization becomes commercial with depth.

Merger Approved

Merger of Gateway Mining Co., Grand Junction, Colo., and Lisbon Uranium Corp., was approved at a special stockholders meeting. Seven and one-half shares of Gateway will be exchanged for one new share of Lisbon Uranium, a firm controlled by affiliates of the Atlas Corp.

New Uraninum Mineral Found

A mineral new to the Northwest, tentatively identified as Thucholite, a hydrocarbon of uranium and thorium was discovered recently on the Spokane Indian Reservation according to officials of Big Smoke Uranium, Inc.

Thucholite sometimes replaces primary uraninite. The present discovery is said to occur in a tuffaceous material along a contact between granite and lava.

Fire at Coal Mine

The Nies Brothers coal mine, four miles west of Roundup, Mont., was destroyed by fire. The fire destroyed a tipple, coal bins, 60 tons of stocked coal, hoists, motors and conveyors. The fire was believed to have been caused by spontaneous combustion in one of the bins. A $5000 improvement program at the mine had just been completed this summer. Reconstruction will begin soon.

Sell Mercury Mine

United Mercury Mine and Mill at Stibnite, Idaho, have been sold to the Holly Uranium Corp. of Rance, N. M., according to a recent report. New owners took over August 1 as a first venture into mercury mining. One furnace has been rebuilt and it is planned to re-build another.

Lands Open to Claim

Approximately 31,320 acres of public domain lands in Southwestern Colorado and Southeastern Utah, withdrawn since March 1948, have been opened to location under mining laws, to application for mineral lease and other forms of public entry. Public Land Order 1223, issued by the Interior Department affects lands near Egnar, Colo., Gateway, Colo., and Moab, Utah. It opens these lands for immediate filing of applications under the Public Land Laws as well as for mineral leasing and application under the Materials Act of July 31, 1947.

Find Primary Uranium Ore

Three 26-year-old Ohio State University geologists recently discovered a uranium deposit in an abandoned silver mine near Crystal, Colo.

According to a partner of the young geologists the AEC assay of ore taken from the old mine shows a uranium content which makes it one of the richer finds of recent record.

Complete Access Road

Idaho Alta Metal Corp. has completed a road to the site of a proposed 1100-ft adit at the old Empire copper mine in Custer County, Idaho. According to report, mining equipment is to be moved in soon. The work is being carried out under the direction of E. G. Bowen, executive vice-president of the company.

Elemental Boron

High grade amorphous boron is being manufactured on a pilot scale by Pacific Coast Borax Co. After two and one-half years of research work they have achieved their objectives of lowering costs and increasing quality to the point where it is now an industrial chemical instead of a laboratory curiosity.

The product is available in two purities. A low grade of 90 to 92 percent will sell for $10 to $13 per lb, and a high grade of 95 to 97 percent will sell for $12 to $15 per lb—both in quantities of 2000 lb or more.

Lithium in Black Hills

Midwest Lithium Corp. has announced that the first complete lithium processing plant in the Black Hills may be ready for operation by the first of the year. The company plans to process lithium at the old U. S. Gypsum Co. plant near Piedmont, S. D.

Present lithium operations in the Black Hills are confined to mining and to concentration plants. Ore is shipped to Minnesota and New Jersey for processing. Plans call for remodeling the plant near Piedmont at a cost of about $100,000, and installing new machinery. The firm plans to use ore from its own and other mines in the area to produce lithium compounds.

Radon Rules and Regulations

As a result of the Seven States Conference held in Salt Lake City in February and the Uranium Mine Operators meetings in Grand Junction, Colo. in August the Regulations given below were adopted and passed by the Industrial Commission of Utah on August 25. These Regulations are an amendment to the General Safety Orders issued by the Industrial Commission of Utah, effective July 1, 1945.

Utah Mining Association plans to arrange clinics in the uranium mining areas of Utah. At these sessions the U. S. Department of Health technicians will demonstrate equipment for making determinations against gas concentration and will instruct operators in the use of that equipment. Clinics will be arranged sometime between mid-November and the last of December 1955.

"It is Ordered: That the General Safety Orders issued by The Industrial Commission of Utah, effective July 1, 1945, are amended by adding the following regulations:

(1) The operator of every uranium mine, whether operated by shaft, slope, tunnel, adit or drift, shall provide and maintain for every such mine a good and sufficient amount of ventilation for such men and animals as may be employed therein, and shall cause an adequate quantity of pure air to circulate through and into all shafts, winzes, levels and all working places of such mine, and except in case of an emergency, no man shall be allowed to work in an atmosphere injurious to health.

(2) The atmospheric concentration of the immediate daughters of radon should not exceed 300 MMCL as determined by a field method acceptable to the State Bureau of Mines (Industrial Commission) and every operator shall make a reasonable effort to approximate said standard.

(3) Rule on Determination of Concentration of the Immediate Daughters of Radon.

It shall be the duty of every operator to cause an inspection of the mine to be made each month for the purpose of determining the concentration of the immediate daughters of radon, provided, however, that at the discretion of the Mine Superintendent or the State Mine Inspector more frequent determinations may be made, and all such determinations shall be made at the working place.

Recording of Determinations

It shall be the duty of the operator to maintain a record book at the mine office wherein the individual making the inspection and determination shall record his findings in his own handwriting and over his own signature, setting forth specifically the time and the place of inspection and determination, and such information (record book) shall be available to the Mine Inspector on request.

This Order shall take effect as of January 1, 1956.

THE INDUSTRIAL COMMISSION
OF UTAH."

Northport Drilling

Northport Copper Co. is planning to diamond drill promising copper-gold showings at its property west of Northport, Wash. Officials of the company said extensive bulldozing has opened many ore veinlets in the Rossland volcanics four and a half miles south of the Canadian boundary. Drilling is planned to probe beneath the oxidized zone.

Copper Company Formed

Organization of the Lewisohn Copper Corp. to explore, develop and operate mining properties in Arizona leased from the estates of Leonard and Sam A. Lewisohn, has been announced by Frederick Lewisohn, chairman of the board.

Mr. Lewisohn is a member of the New York Stock Exchange and a director of the New York Central Railroad. Other officers of the new company are Richard M. Chilson, independent mining operator, who is president and treasurer, and Boyd M. Morse, Tucson attorney, who is vice-president and secretary.

Red Hills and Rimrock Merge

At a meeting in Tonopah, August 13, Red Hill Uranium and Rimrock Uranium agreed to a merger. Properties involved are located in New Mexico, Utah, Colorado and Nevada. Red Hills Co. was organized in 1916. Frank J. Friday, president, stated the office of the merged companies will be in Tonopah, Nev.

Plumas County Tunnel

Boyle Bros. Drilling Co. of Salt Lake City has signed a joint operating agreement with Park-Knold Mines Corp. and Northwest Uranium Co. for driving a 330-ft tunnel on the old Five Bears claims, located in Plumas County, Calif. Objective of the renewed exploration is a copper deposition, determined by investigation of old U. S. Bureau of Mines reports. Boyle Bros. will be paid by a transfer of Park-Knold common stock.

South Dakota Uranium Plant

A multi-million dollar uranium concentrator is under construction at Edgemont, S. D., by Western Knapp Engineering Division of Western Machinery Co. It is being built for Mines Development, Inc. of Denver and is expected to be in operation in the spring of 1956. Plans for the plant, which according to present information will be adequate to handle all production in the area, began in the spring of 1955 and have been finalized with a flowsheet incorporating a recently developed ion-exchange process.

International Mining Days

El Paso, Tex., was the setting of the International Mining Days Convention, September 28 to October 1. Included in the program were three technical sessions covering operating problems relating to ore dressing, uranium, and new underground practices. Luncheon and dinner meetings featured excellent speakers on pertinent topics. Evenings were filled with fun and banquets, and the ladies kept busy with a special program of interesting activities.

Manufacturers Forum

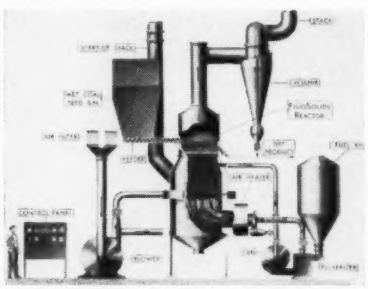
New Rope Belt Conveyor

A radical departure from the conventional style rigid structural frame belt conveyor for mine use is offered in the new Rope Belt Conveyor introduced by Goodman Mfg. Co., Chicago. With this unit the conveyor belt is carried on chain-linked idler rolls suspended between taut parallel wire ropes. The flexibility of the linked

idlers and of the ropes, the company reports, insures shock-free belt travel from start to finish, the idlers and ropes conforming to the load rather than forcing the load to conform to a definite contour or position. The parallel ropes form true alignment between anchor points and the self-aligning idler rolls maintain belt alignment.

Fine Coal Drier

Dorr-Oliver Inc. announces the availability of the Dorrco FluoSolids System for heat drying fine coal. Primary component of the FluoSolids coal drying system is a two-compartment



reactor. In the lower compartment pulverized coal is burned producing the necessary heat for drying. Directly above this compartment is the fluidized drying compartment, separated from the combustion chamber by a specially designed constriction plate. Wet coal is introduced into the fluid bed by a screw conveyor. The coarse, dried product is discharged just below the fluid bed level and the fine, dried material trapped in the exit gases is collected in a cyclone.

The manufacturer claims the major advantage of this fluidized system for drying coal is its high drying capacity. It reports that a single unit may handle as much as 200 tph. Originally developed to dry ¼-in. by 0 coal, the system has successfully dried materials as coarse as ½-in. by 0, the company adds. Further information can be obtained without obligation from Dorr-Oliver Inc., Barry Place, Stamford, Conn.

Bottom Dump Motor Wagon

A new hydraulically operated bottom dump motor wagon, the TW-360, has been added to the Allis-Chalmers Mfg. Company's line of earthmoving and construction machinery. This new

47,000-lb unit is powered by an Allis-Chalmers 280-hp diesel engine providing, at 2100 rpm, forward speeds ranging from three mph in first, to 20 mph in fourth gear. Reverse speed of the TW-360 is 3.1 mph.

The Motor Wagon, with a 22-ft wheel base, has a 22-cu yd heaped and a 17-cu yd struck capacity, or 26 tons.

Operating efficiency and operator comfort is provided by such features as two-speed hydraulic steering, 24-v electric systems, four-wheel air brakes, one-lever control to operate doors which retract along the sides of the body for greater ground clearance and wider door openings. Nearly straight wagon sides eliminate bridging of the earth, the company adds.

Self-Tramming Mobile Conveyor

The Long Co. has introduced a new mobile room conveyor head. The unit is crawler mounted and self-tramming.

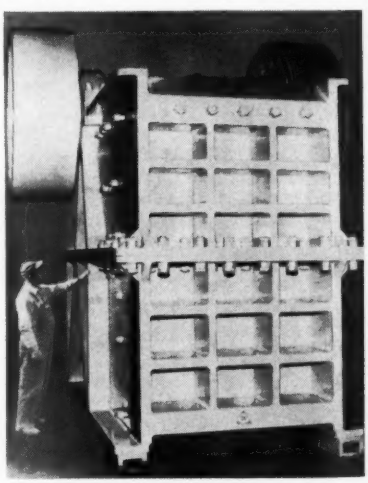
For tramming, the Long mobile conveyor uses a hydraulic system driven by the conveyor motor. It is equipped with a 15- to 40-hp motor to suit a wide range of individual requirements and is furnished with either Long standard or solid return-

trough pans. The company reports that capacities to five tpm are standard and operating lengths to 500 ft are practical, depending on load and grades. For additional details write the manufacturer at P. O. Box 331, Oak Hill, W. Va.

New Denver Jaw Crusher

Denver Equipment Co. has introduced a 36 by 48 in. Type "J" Denver Jaw Crusher to meet operators primary crushing problems.

Sectionalized for ease in handling component parts during installation,

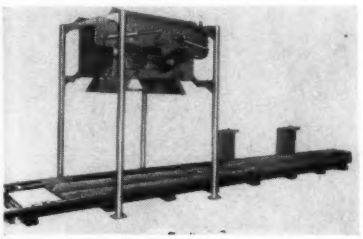


the frame is electric welded three-in. steel plate. Both sections of the crusher frame are stress relieved before machining. The crusher has an estimated capacity of 275 to 750 tph, depending on type of rock and discharge setting. For information write Denver Equipment Co., P. O. Box 5268, Denver 17.

Loading Station

The Nolan Co., Bowerston, Ohio, has announced the marketing of a new Automatic Loading Station for handling coal more efficiently during one phase of its transportation.

Controlled loading of cars is accomplished with a Nolan Loading Bar.



This protects against over-filling either the unit being loaded or the oncoming empty, which receives the coal at the time of car change.

Included in the Nolan Automatic Loading Station are car-body operated valves to secure continuous forward motion at the time of change.

Filtering Unit

A Filter Buggy for on the spot filtration of hydraulic systems and machines has been announced by Schroeder Bros., 3116 Penn Ave., Pittsburgh 1, Pa.

The Buggy has no motors or pumps but uses hydraulic power furnished by the machine itself. It can also be had with pump and motor mounted if desired. The manufacturer reports that the unit will not filter out oil additives nor chemical or water base flame-resistant fluids.

Belt Patching

Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill., has introduced a self-vulcanizing rubber material for repairing bruises, tears and edge damage on conveyor belts. Called

"REMA," the company says that the material can be used without the use of heat or heavy vulcanizing equipment and that no curing time is required. Vulcanizing with "REMA" is a chemical process. The repair is then sealed with an abrasive-resistant over-stock patch.

— *Announcements* —

Robert F. Kaufmann has been appointed vice-president in charge of advertising and public relations for **Precision Radiation Instruments, Inc.**, Los Angeles.

C. Allen Fee has been elected vice-president and secretary of **ACF Industries, Inc.**, according to Charles J. Hardy, Jr., chairman of the board of directors.

Marion Power Shovel Co. has announced the appointment of **William H. McAllister**, of Kansas City, Mo., as its district manager for a five-state area embracing Kansas, Oklahoma, Nebraska, Colorado and the western half of Missouri.

H. J. Buttner has been appointed manager of engineering for the Le Roi Division of **Westinghouse Air Brake Co.**, Milwaukee, Wis.

National Mine Service Co. has been appointed sales and service representative for **Femco** Communication Systems for Mines. The firm will distribute audio and carrier current systems in the mining industry. Complete parts service will be available at all National Mine Service Co. warehouses.

National Mine's service organization established to install and maintain Wheat Cap Lamps will be used to install and service Femco Systems.

W. D. Rothell has been named district manager of the West Coast district of **Stratoflex, Inc.** He replaces A. B. Quinn, who resigned to become president of Harrisburg Sales & Service, Inc.

Harry Jack has been named superintendent of the **Lee-Norse Co.**, Charleroi, Pa. Previous to his joining Lee-Norse he was superintendent of maintenance for the Harmar Coal Co. at Harmarville, Pa.

Heyl & Patterson, Inc., contracting engineers of Pittsburgh, Pa., have recently appointed **George M. Meriwether, Industrial Equipment**, Birmingham, Ala., as its sales representative for special materials handling equipment in the states of Alabama, Mississippi, Georgia, Tennessee, Florida, and Southeastern Louisiana.

CATALOGS & BULLETINS

BELT SELECTION. *Hewitt-Robins Incorporated, Stamford, Conn.* A wall chart on the proper selection and maintenance of conveyor belting is offered to conveyor users by Hewitt-Robins. The chart, measuring 23 in. by 33 in., contains 12 practical maintenance tips for getting more life out of belts. It deals with storage of belts, correct design of loading chutes, use of automatic switches, lubrication, inspection, and other important aspects of maintenance.

DRILL CATALOG. *Hoffman Bros. Drilling Co., Punxsutawney, Pa.* A new general catalog covering the complete line of Hoffman "orienated" drill bits. Designed for quick, easy location of important bit drill data, the catalog lists sizes, setting charges, uses, etc., for all standard bits.

GOODMAN 965 LOADER. *Goodman Mfg. Co., Halsted St. & 48th Place, Chicago 9, Ill.* Bulletin G-112 describes the Goodman 965 coal loader. Having an over-all height of 26½ in., the loader is rated at a capacity of up to 10 tpm in free coal.

HYDRAULIC BOOMS. *Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.* Form 4162 describes I-R's complete line of hydraulic booms for use in the construction and mining industry. Also contained is information on special jumbo mountings including a four-boom, self-propelled machine for drilling a face 40 ft high underground.

JEFFREY CATALOG. *The Jeffrey Mfg. Co., Columbus 16, Ohio.* Booklet No. 888 outlines quickly and concisely the Jeffrey line of products. Formerly titled "What We Make," it has been brought up to date and contains a complete list of Jeffrey products.

PILOT PLANT AND LABORATORY EQUIPMENT. *Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.* Catalog LG3-B10, "Denver Laboratory Equipment," describes over 146 different items to help the mining company establish its own laboratory testing needs. Various divisions of the company's laboratory are discussed. A brief index of a number of ores which have been tested for the recovery of valuable minerals in the Denver Equipment Co. laboratory has given. One section of the catalog discusses "minerals and their characteristics."

POOL WASHING SCREENS. *Allis-Chalmers Mfg. Co., 972 S. 70th St., Milwaukee, Wis.* Allis-Chalmers pool washing screens for handling a wide variety of materials such as limestone, lead, zinc, dolomite, coal, iron ore, tungsten, sand, and phosphates are described in Bulletin 07B8214. The bulletin explains by means of diagrams the advantages of pool washing.

ROLLER BEARINGS. *Dodge Mfg. Corp., Mishawaka, Ind.* Bulletin A-638 features the new SCM line of ball bearing pillow blocks and flange cartridge mounts. In addition it contains up-to-date technical information and list price on the complete line of Dodge SC ball and Dodge-Timken roller bearings. Tabular data includes engineering drawings, dimensions, shaft sizes, weights, radial load ratings and list price.

SKID-SHOVELS. *Drott Mfg. Corp., Milwaukee 8, Wis.* This bulletin lists the complete line of International Drott Skid-Shovels and attachments. The four Skid-Shovels are designed for use with the International T-6 and TD-6 crawler tractors, the T-9 or TD-9; and TD-14A, and the TD-18A. Bucket capacities range from ⅞ to 3 yd.

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Toughest Testing Grounds

...THE MESABI RANGE

New **Run-of-Mine SCALPING SCREEN**

Single pieces weighing as much as four tons . . . hundreds of pounds of sticky material adhering to screen body . . . large volume requirements. These are the demanding conditions under which this screen is setting new performance standards.

Here are some of the many features which enable this screen to meet severe duty with *minimum maintenance:*

Extra-Large Bearings (largest ever installed in an A-C screen) withstand punishing loads. Bearing life is extended, replacement less frequent.

Simplified Two-Bearing Mechanism reduces maintenance time and cost.

Cartridge Mechanism can be pulled out after merely removing sheave and four bolts.

Sturdy Channel Construction features 12-inch I-beam deck support.

Soft Support Springs provide smooth, balanced operation. No need to remove adhering material. Practically no vibration transmitted to building.

For information on this extra-heavy-duty screen and other Allis-Chalmers screens applicable to your operation, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

***Designed to Team Up With Primary Crushers* to handle the toughest job on any mining flow sheet.**

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This complete M-S-A mining area coverage gives you the advantage of LOCAL stocks and service

There are few industries where prompt service and "at hand" sales facilities are more vital than in the mining industries. Continuous production is your prime concern—lost time due to delayed shipments, emergency need of repairs or parts for equipment can be avoided by the use of established M-S-A local stocks and trained personnel.

Sixty-eight representatives in twenty-two states and Canada make it their business to see that M-S-A customers have what they want when they need it. Which proves again that our slogan . . . *"When you have a safety problem, M-S-A is at your service. Our job is to help you."* . . . means what it says, wherever you do business. We'll be happy to tell you more about M-S-A Service, and M-S-A products.

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